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NASOGENITAL RELATIONSHIP

REVIEW OF THE LITERATURE

RAYMOND S. ROSEDALE, M.D.
CANTON, OHIO

he indexed literature concerning a relation- between the nose and the genital organs reviewed by me following a request that rite a chapter on the nasogenital relationship a new textbook of obstetrics. Prior to the ew of the literature I was aware of a rela- ship in a general way but was not cognizant he number of laboratory experiments which been done in this field. It was felt that a lar absence of recognition and appreciation ht exist with some other otolaryngologists. lizing that the accumulation of the various es of literature and their perusal and ab- ction require a considerable amount of time- suming effort and that every one is not able give the required time, I decided to present mmation of the literature in the form of a er for publication. The paper does not con- any results of observations or experiments le by me. Conclusions have purposely been tted.

relationship between the nose and the geni- organs has probably been suspected from the iest times, but only within the past decade e any substantiative reports based on labora- work appeared. Most of the medical reports e been based on pure matter of opinion or clinical observation or on both. Some re- ts seem to lead one into the realm of the iful and at times the grotesque. Relatively seem to have scientific value.

Only the scantiest reference to the subject was nd in reviewing the recent textbooks of oto- ngology. Proetz,[1] in his book "Applied siology of the Nose," has written the best iew of the subject, but this is necessarily f in a text which has so many phases of the blem to consider.

One might consider the nasogenital relation- p from, first, the point of view of those who e described the clinical relationships and made comprehensive review of the literature and, ond, from the point of view of those who have not only reviewed the literature but done experimental research on the problem.

In regard to the clinical side, MacKenzie[2] in 1884 pointed out the erectile properties of the tissues covering the inferior and middle turbinate bones and part of the septum and compared them with those of the penis. In women these tissues were noted by him to be more turgid just before or during the menstrual period. He also noted that not infrequently the nasal symptoms of some women were more pronounced during the menstrual period.

Endriss[3] in 1892 reviewed the literature on this subject and found that most of the citations were concerned with epistaxis and its association with sexual function. He reported that nasal symptoms of genital excitation were sneezing, headaches, nasal obstruction and changes in the nasal secretion which accompanied menstruation, coitus, pregnancy and onanism. He also mentioned the possibility of olfactory hallucinations at the menopause and of anosmia following castration and the menopause.

Fliess[4] in 1910 described the genital areas of the nasal turbinates and the septum. Brettauer[5] in 1911 reported on the intranasal therapy of dysmenorrhea.

Thomson[6] in 1911 made this statement in his textbook: "Undoubtedly there is a reflex action between the pituitary membrane and the genital organ—bleeding is frequent from the nose at puberty." He referred to a paper on the subject by Joal,[7] in 1888, and also to an

1. Proetz, A. W.: Applied Physiology of the Nose, Louis, Annals Publishing Company, 1941, pp. 320-322.

2. MacKenzie, J. N.: Irritation of the Sexual Apparatus as an Etiological Factor in the Production of Nasal Disease, Am. J. M. Sc. **87**:365, 1884.

3. Endriss, G.: Die bisherigen Beobachtungen von physiologischen und pathologischen Beziehungen der oberen Luftwege zu den Sexualorganen, Würzburg, Becker, 1892.

4. Fliess, W.: Die Beziehungen zwischen Nase und weiblichen Geschlechtsorganen in ihrer biologischen Bedeutung dargestellt, Leipzig, F. Deuticke, 1897.

5. Brettauer, J.: Dysmenorrhea Relieved by Nasal Treatment, Am. J. Obst. & Gynec. **64**:214, 1911.

6. Thomson, St. C.: Diseases of the Nose and Throat, London, Cassell & Co., 1911, p. 181.

7. Joal: De l'épistaxis génitale, Rev. mens. de laryng. **8**:74 and 129, 1888.

observation by Trousseau that the odor of ozena is worse during the period of menstruation and that it improves during pregnancy. He concluded his brief remarks by saying that sexual disorders may be found to be productive of various troubles in the nose and throat.

Klotz [8] expressed the belief that periodic nasal manifestations in conjunction with menstruation are frequent. It was stated by him that in some women the beginning of menstruation is accompanied by pain in the side of the nose and a sense of nasal obstruction, these symptoms being aggravated by lying down. He described increased nasal discharge, sometimes with a disagreeable odor coming from the nostrils of some of the patients. He thought that these symptoms appeared with the beginning of menstruation and ended on the third day. He referred to a paucity of objective nasal observations in most cases, but in some instances he had noted a redness of the mucous membrane. Epistaxis during menstruation was a more common finding. He thought it advisable to abstain from nasal operations during the menstrual period because of the predisposition toward nasal hemorrhage during this time. A reference was made to the accentuation of ozena during menstruation and that in certain cases of atrophic rhinitis, not always ozena, there is a bad nasal odor at the menstrual time.

Proetz [1] wrote that association between the two has long been recognized but that, even at the present time, it is not understood. He continued:

> . . . all manner of menstrual disturbances have been said to have been relieved by stimulation, cocainization, and cauterization of precisely the right point in the nose, but the point varies. . . . Probably the changes in the nose accompanying genital aberrations are more frequently their effect than their cause.

Proetz also pointed out the frequency of recurrence of edema and polyposis with successive pregnancies and the amelioration of the nasal symptoms of patients with atrophic rhinitis during pregnancy.

Magnotti [9] conducted an interesting experiment in which he extirpated the olfactory bulbs in 8 male and 8 female guinea pigs, in which he also destroyed visual perception by cauterization of the corneas. He then grouped normal animals of the opposite sex with his experimental animals, males and females in pairs, in separate cages. As controls he placed a normal m and a normal female under observation. S of the animals died quickly, but others live long as five months. In the group of ani on which he had operated, there was no dem strable sexual desire, and no litters develo He was able to demonstrate microscopic what he believed to be arrested developme testicles, ovaries and tubes in the experime animals from which he had removed the olfac bulbs.

Karpow [10] observed that in 40 rabbits, gu pigs and dogs extirpation of the inferior binates was followed by deficient develop of the genital tract. He also showed that w aqueous extractions of the inferior middle binates of a guinea pig caused contraction, w increased tonus, in strips of uterine muscula of the same animal. This contraction greater in animals that had been pregnant were pregnant. He expressed the belief he was dealing with a specific uterine stimula substance isolated from the turbinates.

Terbutt [11] in 1938 reported that in 12 m keys and 7 human subjects testosterone ac and testosterone propionate effected cha in specialized nasal areas in both male female monkeys. Grossly there were swel and increased secretion. Microscopically observed pronounced perivascular edema in th areas. He thought that the reacting areas w similar to those which would exhibit vicari menstruation.

Rosen [12] in 1938, after mentioning the clin association of periodic epistaxis with menstr tion and of stuffiness of the nose with copulat and sexual excitation, and the improvement some cases of ozena during menstruation, ported that in laboratory experiments gona tomy is followed by degenerative changes in nasal mucosa. In his own experiments he fo also that white albino rats exhibited the findi of pseudopregnancy after silver nitrate had b applied intranasally.

Hamilton [13] in 1937 injected testosterone p pionate into 15 monkeys and 8 human s jects, provoking swelling, narrowing and c

8. Klotz, A.: Fosses nasales et ovaires, Presse méd. **44**:2091, 1936.

9. Magnotti, T.: L'importanza dell'olfatto sullo sviluppo e funzione degli organi genitali, Boll. d. mal. d. orecchio, d. gola, d. naso **54**:281, 1936.

10. Karpow, N.: Zur Frage des Zusammenhangs Nase mit der Sexualsphäre, Monatschr. f. Ohrenh. 758, 1929.

11. Terbutt, H. A.: Male Hormone: Effect upon Nasal Mucosa of Man and Monkey, New York S J. Med. **38**:332, 1938.

12. Rosen, S.: The Nasogenital Relationship, A Otolaryng. **28**:556 (Oct.) 1938.

13. Hamilton, J. B.: Changes in Nasal Mucosa Monkeys (Macaca Rhesi) and Humans by M Hormone Substances, Proc. Soc. Exper. Biol. & M **37**:366, 1937.

ion, and increased moisture in specialized
l areas of the turbinates in both species. In
turbinates of both the male and the female
keys he reported perivascular congestion.
stated that the nasal areas were similar
nose which produced vicarious menstruation.
his third contribution, in 1942, Rosen [14]
ed that he observed the changes of pseudo-
nancy in rats following interruption of the
olfactory nasal innervation by excision of
sphenopalatine ganglion. He suggested the
ibility of a continuous nerve pathway from
vidian ganglion to the sheath and the sub-
ce of the anterior lobe of the pituitary gland;
as implied that the relationship of the nose
he genital organs may be that of nerve
ulation from the nose to the anterior lobe
he pituitary gland and that of hormonal
ulation from that source to the gonads.

ggston [15] in 1940 extracted nasal and sinal
osa from freshly slaughtered cattle, using a
nic which had been applied in the extraction
he gonadotropic fraction of the anterior lobe
he pituitary gland. The extract was injected
young female mice subcutaneously for a
od of days, and then the uterus, tubes and
ries were removed and weighed. He found
in some animals the weight of these organs
double that in the control animals. He
rted congestion and edema of the tubes and
uterus. He concluded from his work that
mucous membrane of the nose and sinuses
attle contained an estrogenic hormone. He
ld not state whether this was secreted by
glands of such mucous membranes or whether
as concentrated selectively within them. He
careful to point out that many plant and
nal tissues may be a source of estrogenic
stances.

n a paper on the nasogenital relationship,
elesnyak and Rosen [16] reported that in labora-
y work they had studied the effects of stim-
ion and of depression of the nasal mucous
mbrane on the induction of pseudopregnancy
rats. They found that stimulation with
m sinapis appeared to affect the regu-
ty of the estrus cycle, principally in the
icular phase, and that the depressing sub-
nces, tannic acid and trichloroacetic acid, pro-
ed prolongation of the diestrual phase in some

4. Rosen, S.: Nasogenital Relationship: Nervous
so-Pituitary Pathway, J. Mt. Sinai Hosp. **9**:755, 1942.
5. Eggston, A. A.: Experimental Evidence of
adotropic Hormone in Nasal and Sinus Mucous
mbranes, Laryngoscope **50**:191, 1940.
6. Shelesnyak, M. C., and Rosen, S.: Naso-Genital
ationship: Induction of Pseudo-Pregnancy in Rat by
al Treatment, Endocrinology **23**:58, 1938.

of their adult female rats. In 58 of 115 animals they produced pseudopregnancy by anesthetizing the nasal mucosa with nupercaine hydrochloride. In some of the latter animals, gross decidua followed traumatization of the uterus.

Mortimer, Wright and Collip,[17] in an important contribution concerning the effects of the administration of estrogens on the nasal mucosa of the monkey, reviewed previous laboratory experiments. They referred to the sexual hypoplasia observed in dogs and rabbits by Koblanck and Roeder [18] following removal of the turbinates of young dogs and rabbits. The number of animals used was too small to permit any positive conclusion. They also mentioned the work of Karpow,[10] referred to earlier in this paper, in which double turbinectomies on male rabbits were followed by failure of descent and loss of weight of the testicles. They quoted the paper of Nemours,[19] in 1935, who repeated Karpow's experiments and found similar changes. They alluded to the degenerative changes in the nasal tissues of rabbits following castration reported by Borghesan [20] in 1931 and the confirmation of Borghesan's work by Pighini and Porta [21] in 1934. Both of these workers noted that there was some restoration of the degenerated areas of the nose following the application of liquor folliculi to the affected parts and that the improvement was more marked after the exhibition of a crude extract of the anterior lobe of the pituitary gland. Pighini and Porta considered the improvement of the nasal condition as probably due to the growth hormone of the thyrotropic fraction of the anterior lobe of the pituitary gland. Reference was also made to Wiraboff,[22] who made histologic studies of the nasal mucosa obtained at different periods of the sex cycle. He was unable to reach any conclusion about the relationship of the nasal mucosa to the sex cycle. Mortimer, Wright and

17. Mortimer, H.; Wright, R. P., and Collip, J. B.: The Effect of the Administration of Estrogenic Hormones in the Nasal Mucosa of the Monkey (Macaca Mulatta), Canad. M. A. J. **35**:503, 1936.

18. Koblanck and Roeder, H.: Tierversuche über Beeinflussung des Sexualsystems durch nasale Eingriffe, Berl. klin. Wchnschr. **49**:1893, 1912.

19. Nemours, P. R.: Effect of Experimental Bilateral Turbinectomy on the Development of the Testes in the Rat, Arch. Otolaryng. **22**:626 (Nov.) 1935.

20. Borghesan, E.: Alterazioni dello scheletro e della mucosa nasale in un caso di ipofunzione ovarica, cited by Pighini and Porta.[21]

21. Pighini, G., and Porta, C. F.: L'azione reintegrativa degli estratti anteipofisari ed ovarici sulle alterazioni sperimentali della mucosa ed ossa nasali da castrazione, Valsalva **10**:140, 1934.

22. Wiraboff, A.: Relations entre la muqueuse du nez et l'activité fonctionelle des glandes génitales, Rev. de laryng. **55**:896, 1934.

Collip [17] in their original work on Macaca mulatta concluded that there is a specific gross and microscopic influence of the mucous membrane of the middle and inferior turbinates in response to the administration of estrogens. This influence is characteristically shown in reddening and swelling of the nasal mucosa, which are associated with the sex changes known to occur in the nipple and the sex areas of the skin of the face and the back. It occurs in immature and mature males as well as females. They also determined that there are premenstrual exaltations of nasal activity in untreated immature and adult female animals and that for the most part these peaks are particularly marked in the autumn, which is the period of greatest fertility for their animals. In a subsequent paper, in 1936, they concluded that the hormones of the ovary have a specific physiologic nasal effect during the menstrual cycle in the monkey and during the pregnancy of a human being. This is characterized as hyperemia followed by perivascular edema of the submucosa which, if prolonged or excessive, leads to cellular infiltration and prominent enlargement of the turbinates. Mortimer [23] in 1940 reported that there is a parallel between the increasing hyperemia of the turbinates and the increasing elimination of estrogen in the urine at pregnancy and that these both fall off sharply after delivery. He stated that it is this knowledge that makes possible the control of atrophic rhinitis in patients with spontaneous atrophy of the mucosa and depression of functional activity of its glands. He expressed the belief, as did Bachman, Collip and Selye,[24] that through phylogeny some primates have developed in certain epithelial areas the power of representing visibly the varying levels of the circulating estrogen.

Ogihara,[25] in 1938, in what he termed fourth contribution, reported on the changes the vaginal secretions in female rats in wh the nasal mucosa was treated. On apply saline solution diluted with alcohol to the n he observed a slight increase of the sex function. This was transitory. When the plication was more prolonged, the exaltation the sexual function was followed by depress With "moderate" stimulations, obtained w two injections of 70 per cent alcohol, the function in the beginning was depressed later increased. When he applied a spray tincture of iodine or a 10 per cent silver nitr solution, the sex function was definitely pressed and remained so for a long time. Wh cocaine was applied, the sex function was a depressed in accordance with the concentrati of the cocaine. He expressed the belief th his findings showed that the female sex fu tion on stimulation or anesthetization of the n mucosa will show various changes in accorda with the degree of stimulation or anesthetizati He also observed that if the turbinates w removed, the changes in sex function w definite as far as the stimulants were concern That is to say that with ordinary irritation changes appeared quickly and lasted a sh time, whereas with anesthetization of the t binates they appeared slowly, within three wee and seemed to last forever. He finally conclud that in view of his results the disturbance the function of the sex organs produced extirpation of the anterior turbinates must attributed to the removal of a specific substan contained in the turbinates. He implied, ho ever, that there might also be a neurolo influence.

610 North Market Avenue.

23. Mortimer, H.: Genito-Nasal and Genito-Aural Relationship, Laryngoscope **50**:349, 1940.

24. Bachman, C.; Collip, J. B., and Selye, H.: Further Studies of Sex-Skin Reactions in Macaca Mulatta, Proc. Soc. Exper. Biol. & Med. **33**:549, 1936.

25. Ogihara, M.: Experimental Study of the Re tionship Between the Nasal Cavity and the Function the Female Sex Organs: Experimental Study, Mitt. a med. Akad. zu Kioto **23**:219, 1938.

DEVELOPMENT OF THE COCHLEAR AQUEDUCT AND THE ROUND WINDOW MEMBRANE IN THE HUMAN EMBRYO

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NEW YORK

The physiologic importance of the cochlear educt and the question of its patency still be- to the moot chapters of otology. Streeter [1] cribed the aqueduct in 85 and 130 mm. fetuses a tubular pouch projecting from the sub- hnoid spaces along the glossopharyngeal e toward the scala tympani and came to the clusion that the communication had to be blished soon after this stage. Karlefors [2] tified the first anlage of the aqueduct in a and 65 mm. embryo as a more or less dense nective tissue which connected the scala tym- with the glossopharyngeal nerve. Later the nective tissue becomes loose to the extent that men is formed in that portion of the aqueduct ch is close to the posterior cerebral fossa. The nective tissue of the aqueduct continues with lining of the scala tympani on one side and the dura and the arachnoidea or the posterior a on the other side. Finally Karlefors stated in most instances a loose and a dense con- ive tissue lining run parallel to each other in aqueduct and together form a subdural and barachnoid space.

The present studies were undertaken with the e of throwing some light on the significance several anatomic structures and possibly on physiology of the cochlear aqueduct. The e spatial relationship of the round window h the aqueduct made the study of the former erative. An answer to the peculiar role of the mbrane of the round window in infections of inner ear was sought. Hardly any data, wever, were found in the literature on the velopment of the round window membrane.

METHOD

This investigation is based on a study of serial sections of specimens ranging from embryos measuring 12 mm. from crown to rump to infants 4 weeks of age. This method was preferred to that in which liquids are injected through the cochlear aqueduct because routes of communication are usually formed as artefacts with the latter procedure and the question of patency could not be answered by this mode of experimentation. In order to preserve the original relationship between the arachnoidea and the cochlear aqueduct, temporal bones were in most instances decalcified and embedded with the contents of the posterior cerebral fossa in situ. Tearing and pulling of some of the soft tissues of the cochlear aqueduct in adults during autopsies are hardly avoidable. Both ears were examined in all specimens.

OBSERVATIONS

1. In a 15.8 mm. embryo (C.C. [Carnegie Collection] no. 4405) the primordium of the cochlear aqueduct was as yet not recognizable in the precartilage which surrounded the otic vesicle. The glossopharyngeal nerve was lined by a loose network of mesenchymal tissue.

2. In an 18 mm. embryo (C.C. no. 4501) a rarefaction of the precartilage between the ninth nerve and the otic epithelium was recognizable. The area of rarefaction corresponded to that portion of the otic capsule which was traversed by the cochlear aqueduct in older embryos. The increase in width of the intercellular spaces of the precartilage represented the anlage of the aqueduct. This was the first stage in the formation of a gap in the otic capsule, which in turn was formed by uniformly arranged precartilaginous cells.

3. In a 22 mm. embryo (C.C. no. 4361) there was present a marked progressive rarefaction of the precartilage in the area of the aqueduct; a clearcut gap was thus formed, which was filled by precartilaginous cells with increasingly larger intercellular spaces.

4. In another 22 mm. embryo (C.C. no. 5537) the features were similar. In addition, the precartilaginous otic capsule was indented just opposite the glossopharyngeal nerve, and the shallow lacuna thus formed was filled out by syncytial cells with long protoplasmic processes. This syncytium could be clearly differentiated from the precartilage.

5. In a 25 mm. embryo (C.C. no. 4304) the rarefied precartilage of the anlage was replaced by flat fusiform cells, in many instances with long protoplasmic processes in syncytial arrangement. This regressive change of the precartilaginous otic capsule into an earlier embryonic mesenchymal tissue extended the entire width of the capsule from the ninth cranial nerve to the scala tympani in the area of the aqueduct. Similar changes were taking place in the scalae of the cochlea.

The specimens marked C.C. (Carnegie Collection) e lent by the Carnegie Institute, Baltimore.

From the Department of Otolaryngology of the umbia University College of Physicians and Sur- ns and the Presbyterian Hospital.

This study was assisted by grants from the Research ncil of the American Otological Society and the yden-Coakley Fund.

1. Streeter, G. L.: The Development of the Scala mpani, Scala Vestibuli and Perioticular Cistern in the man Embryo, Am. J. Anat. **21**:320, 1917.

2. Karlefors, J.: Die Entwicklung des Aqueductus chleae, Acta oto-laryng., 1924, supp. 4, p. 69.

6. In a 27 mm. embryo (C.C. no. 5621) the otic capsule showed a still wider gap which corresponded to the cochlear aqueduct. Most of the precartilage which previously occupied the place of the aqueduct had been already transformed into syncytial tissue with the exception of an island of closely packed cells which still more or less bore the characteristics of cartilage (fig. 1). The loose syncytial tissue was rich in vessels.

In some places flat elongated cells, several layers thick, lined the cartilaginous wall of the aqueduct. Later in fetal life the dura-like lining of the fully developed cochlear aqueduct develops from these cells. A condensation of syncytial cells was taking place in the area which would be occupied by the round window membrane in a later state of development.

7. In a 2 month old embryo (10 Kelly B) the precartilaginous capsule showed a narrow gap through its entire width, and this gap was filled with cells similar in size and staining to the precartilaginous cells; however, the cells of the aqueduct were closely packed, and neither the protoplasm nor the capsule of the cartilage cells was any longer recognizable. While the rest of the cartilaginous capsule was devoid of vessels, the area of the aqueduct, in contrast, was crossed by numerous capillaries which were filled with blood.

8. In a 32 mm. embryo (C.C. no. 5154) the aqueduct was 0.28 mm. wide. The aqueduct was almost completely filled by somewhat elongated cells with long protoplasmic processes except for small islands of deeper staining round precartilaginous cells. Under high power magnification some of the precartilaginous cells still showed a faintly staining cell border, while others had lost this faculty; still others displayed syncytial protoplasmic processes. Capillaries were still present in the aqueduct but in a somewhat smaller number than in the 24 or 27 mm. embryos. The arachnoidal [illegible] which surrounded the ninth cranial nerve went directly into the syncytium of the aqueduct; orient[illegible] and elongation of the arachnoid cells in the dire[illegible] of the axis of the aqueduct were clearly visible.

9. In a 37 mm. embryo (C.C. no. 4415) a pill[illegible] loose syncytial tissue measuring 0.14 mm. separated ganglion of the ninth nerve from the scala tym[illegible] This syncytium was free of vessels. Some transfo[illegible] tion of cartilage was still taking place, forming a [illegible] line along the wall of the entire aqueduct. The [illegible] of the cochlear aqueduct, which has been called some authors the cochlear vein, distinctly appeare[illegible] this stage for the first time. It was embedde[illegible] syncytial tissue which separated it from the cartilag[illegible] capsule. The wall of the vein was formed by a si[illegible] layer of flat, somewhat fusiform cells which bore [illegible]

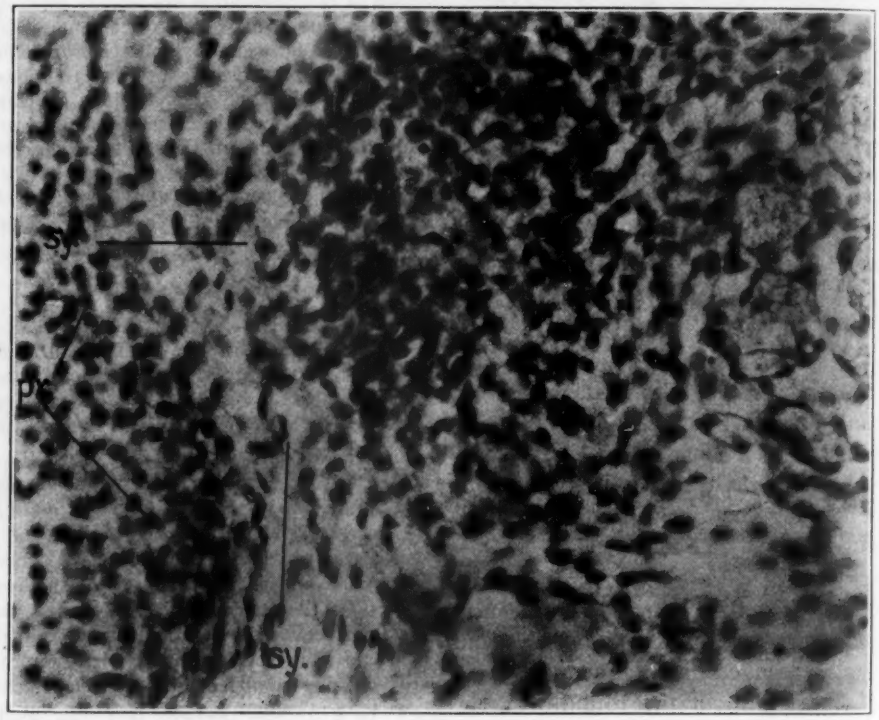


Fig. 1.—High power magnification of the cochlear aqueduct in a 27 mm. embryo: *pr.*, precartilage; *sy.*, [illegible] cytium.

resemblance to the rest of the syncytial cells of [illegible] aqueduct. The vein contained blood and could be tra[illegible] into the scala tympani, where its wall in some pla[illegible] was formed by long protoplasmic processes only; [illegible] course inside the scala tympani was already similar [illegible] that observed in adults. It emptied into the infe[illegible] petrosal sinus, which was separated from the gangl[illegible] of the glossopharyngeal nerve by two to three layers [illegible] syncytial cells. The connection of the inferior petro[illegible] sinus with the sigmoid sinus was already developed.

10. In a 41 mm. embryo (C.C. no. 4985) both [illegible] width and the length of the aqueduct were about [illegible] mm. The aqueduct was completely filled with syncy[illegible] tissue. The ninth cranial nerve had been somew[illegible] dislocated during the preparation of this specimen; [illegible] arachnoidea of the nerve was clearly visible as it [illegible] tered the aqueduct and continued into the syncytium [illegible] the duct. In the center of the aqueduct there was

y pouch measuring 0.046 mm. by 0.1 mm., which lined by a single layer of elongated flat cells and h could be traced into the horizontal portion of cala tympani. This pouch represented the vein of ochlear aqueduct. The mesenchymal tissue which out the middle ear cavity and the future niche of round window was almost identical with the syn- m of the aqueduct, although the intercellular spaces e aqueduct were considerably smaller. The round ow membrane was only partially differentiated at stage and was represented by a beginning condensa- of the syncytium of the niche. The mesenchymal g of the posterior cerebral fossa was identical in esses that transgressed into the syncytium of the aqueduct, which was devoid of vessels. The cochlear vein had been cut in several places as it traversed the aqueduct and contained blood. The cartilaginous cells bordering the aqueduct showed marked condensation, thus sharply separating the cartilaginous capsule from the syncytium. This may be the earliest appearance of the perichondrium in the aqueduct. The similarity between the reticulum of the perilymphatic spaces of the cochlea and the syncytium of the aqueduct was evident.

13. In a 58 mm. embryo (C.C. no. 4229) the marginal syncytium along the walls of the aqueduct showed a

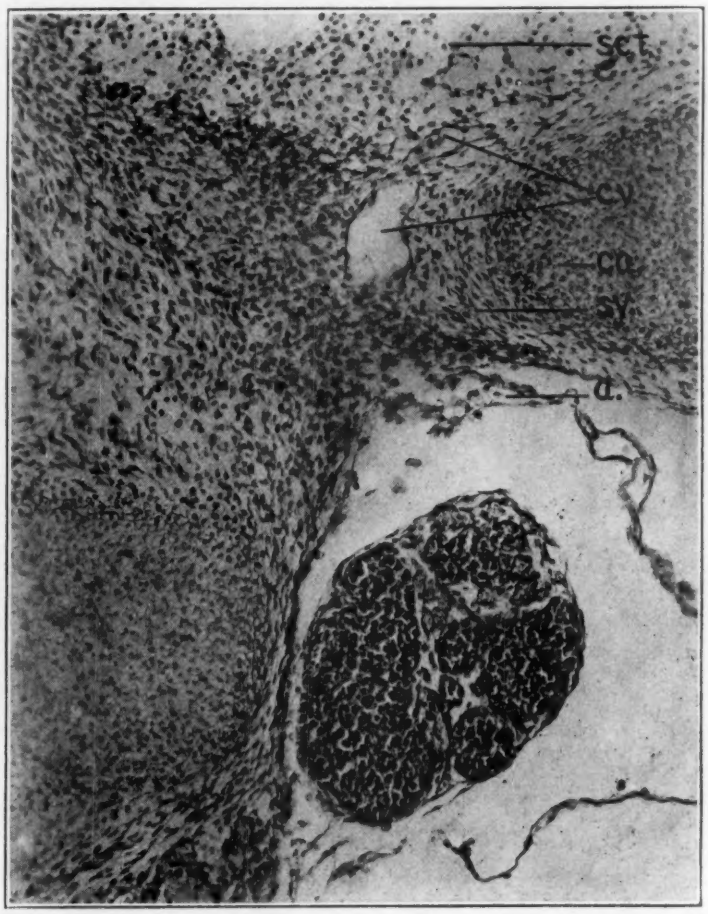


Fig. 2.—Low power magnification of the cochlear aqueduct in a 41 mm. embryo. Note the large cochlear n passing within the syncytium of the aqueduct into the scala tympani. *c.v.* indicates the cochlear vein; *a.*, chnoidea; *ca.*, cartilage of the otic capsule; *sc.t.*, scala tympani; *sy.*, syncytium of the aqueduct.

ucture with the syncytium of the aqueduct, which tained a few capillaries only (figs. 2 and 3).

1. In a 45 mm. embryo (C.C. no. 5561) there was sent in the center of the aqueduct a cord of dense cytial tissue which seemed to be the forerunner of imilar structure that frequently is observed in adults. e round window membrane was getting thicker and dually blended into the syncytium of the niche of round window.

2. In a 54 mm. embryo (C.C. no. 3990) syncytial ue measuring 0.46 mm. separated the ninth nerve m the scala tympani; this measurement can be en as the length of the aqueduct. The ninth nerve s surrounded by cells with long protoplasmic proc- markedly dense arrangement to the extent that cytoplasm and protoplasmic processes were no longer recognizable. In the central three fourths of the aqueduct the syncytium showed no change.

14. A 69 mm. (C.C. no. 4291) and a 78.5 mm. (C.C. no. 1455) fetus gave no additional information.

15. In an 85 mm. fetus (C.C. no. 1400) the aqueduct showed a straight course and was about 0.9 mm. long. In the center of the aqueduct there was a large free lumen which was formed by a single layer of endothelium-like cells surrounded by syncytial cells, which in turn separated the scala tympani from the ninth nerve. This lumen measured 0.14 by 0.7 mm. and contained a moderate number of cell shadows of erythro-

cytes. The structure of this lumen was identical with that of the cochlear vein of the 37 mm. embryo. The differentiation of the syncytium into a dense peripheral tissue and a loose central reticulum was clearcut. The intercellular spaces of the central loose part were, however, smaller than those in younger embryos. Both the dura surrounding the ninth nerve and the round window membrane were made of densely arranged parallel flat cells, which bore a close resemblance to the syncytium of the aqueduct; occasionally even the protoplasmic processes could be seen in the cells of the round window membrane. The loose reticulum surrounding the ninth cranial nerve blended into that of the aqueduct without a sharp boundary. Because of this vessel only. The loose syncytium of the r window niche was separated from that of the aque only by the aforementioned peripheral condensatio cells, which in turn directly continued with the simi formed membrana propria of the round window m brane.

17. In a 110 mm. fetus (SA.110) the aque measured 0.28 mm. at its narrowest portion, whil length was 1 mm. There was a thin layer of d peripheral connective tissue and a central loose sy ium containing many capillaries. The cochlear was large, passed within the central syncytium and formed by a single ring of syncytial cells. The could be traced into the scala tympani. There wa

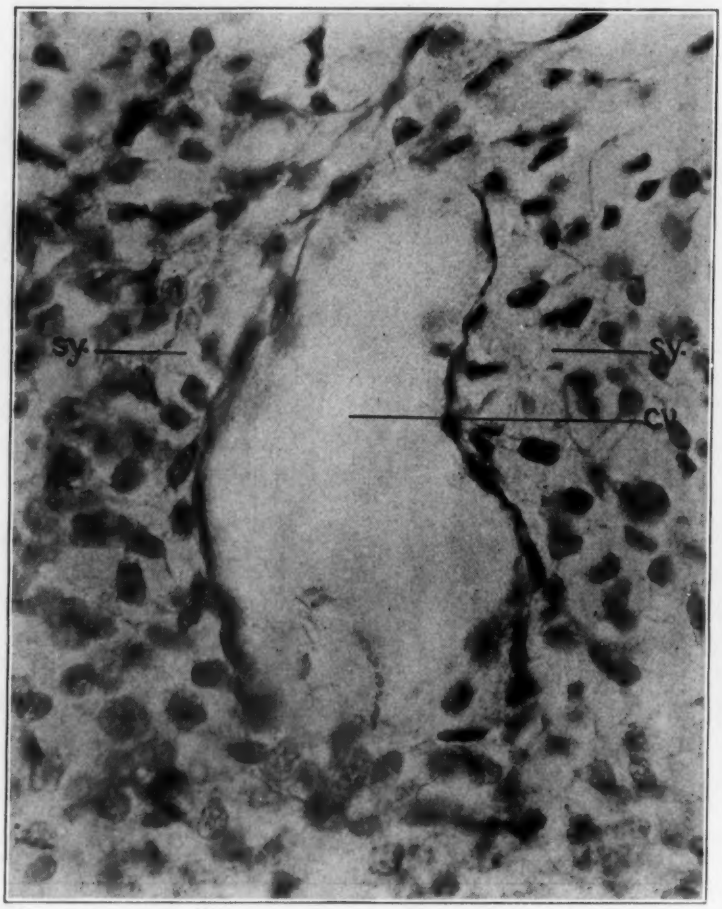


Fig. 3.—High power magnification of the cochlear vein shown in figure 2. The narrow intracochlear port of the vein is not visible. Note the syncytial character of the surrounding cells. *c.v.* indicates the cochlear v *sy.*, syncytium of the aqueduct.

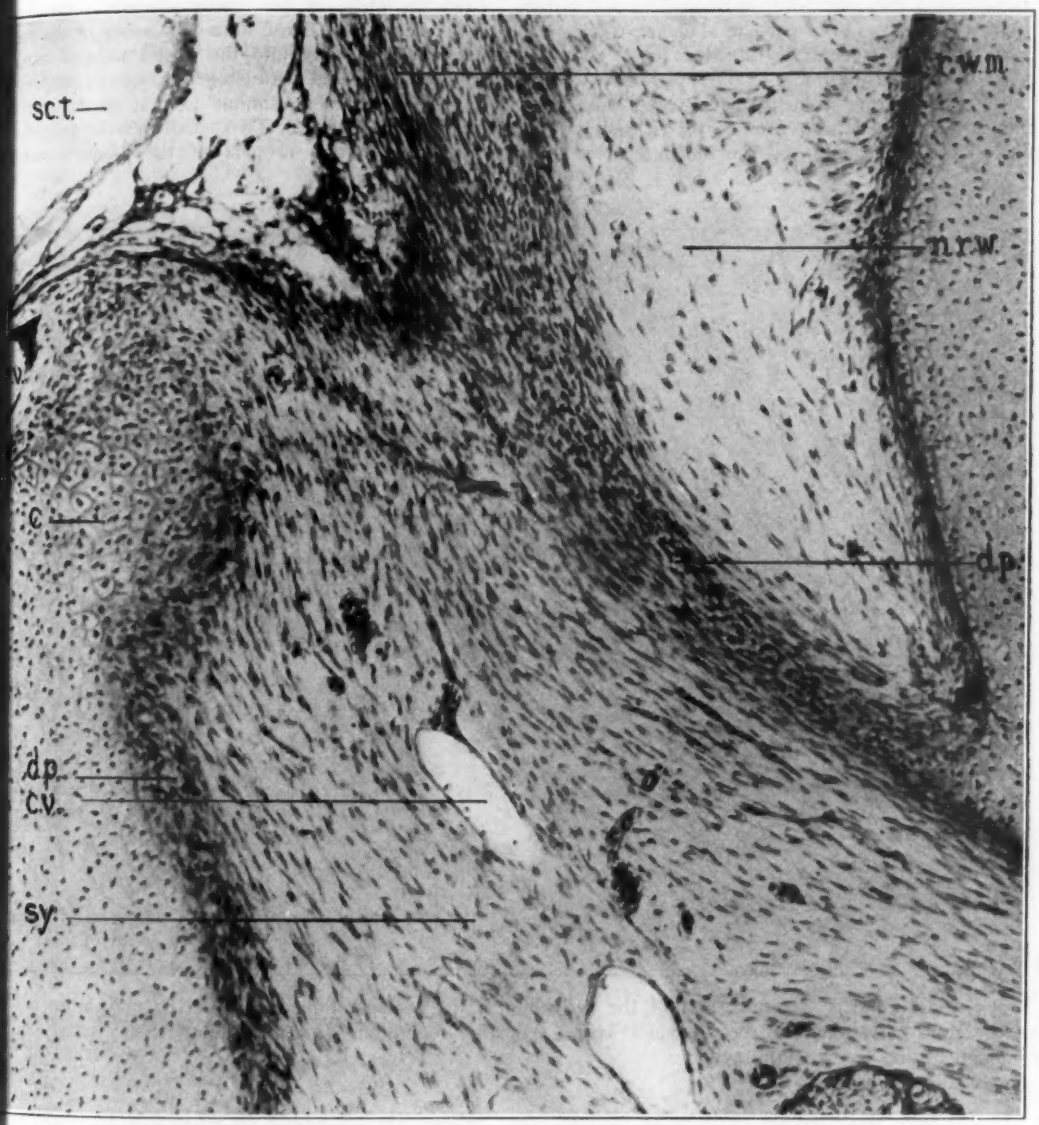
their histologic identity, there was no way of discerning where one stopped and the other started.

16. In a 90 mm. fetus (SA.90) the aqueduct was filled with loose syncytium and a thin layer of the same, formed by peripheral condensation, covered the cartilaginous walls. Within the syncytium a large cochlear vein passed into the scala tympani and inferiorly opened widely into the inferior petrosal sinus. This vein measured 0.8 by 0.15 mm., contained blood and occupied about one fifth of the central portion of the aqueduct, in which no other lumen was found. The ganglion of the glossopharyngeal nerve was surrounded by syncytial tissue and was separated from the vein by the wall of free lumen in the aqueduct. The round window m brane averaged 0.1 mm. in thickness. One single la of enchondrial cells covered the inner surface of membrana propria, while the niche of the round wind was filled with loose syncytium; therefore, there not yet present a mucosal covering. No vessels w found in the membrana propria, while the tissue the niche was rich in capillaries. In several secti the syncytium of the aqueduct was separated from t of the niche by the peripheral dura-like lining of aqueduct only (fig. 4).

18. In a 4 month old fetus (E.A. 4) the aqued measured 0.45 by 0.7 mm. Its course was strai

mediolateral in the coronary direction and was d at the level of the ampulla of the posterior ircular canal. The meningeal covering of the opharyngeal nerve was seen blending into the tium of the aqueduct. The opening of the aque- into the scala tympani was honeycombed by a syncytium. The aqueduct contained many blood- capillaries, which became more numerous as one ached the ninth nerve. The aqueduct widely com- pria. There were several blood-filled capillaries inside the membrana propria.

19. In a 4½ month old fetus (E.B. 4½ A.) there were no essential differences in comparison with the one of 4 months. Some of the syncytial cells of the aqueduct showed star-shaped protoplasmic processes. Many capillaries the size of a red blood cell crossed the syncytium. A funnel-shaped constriction of the aqueduct now started to be evident close to the scala



g. 4.—Cochlear aqueduct of a 110 mm. fetus. The aqueduct is separated from the niche of the round ow by the dura-periosteum of the aqueduct only. *d.p.* indicates dura-periosteum of the aqueduct; *c.v.*, the ear vein; *r.w.m.*, round window membrane; *sc.t.*, scala tympani; *sy.*, syncytium of the aqueduct; *c.*, carti- of the cochlea; *n.r.w.*, niche of the round window.

cated with the niche of the round window, and yncytium of the duct blended into the looser re- m of the niche. The cochlear vein passed within yncytium of the aqueduct. The round window rane was partially developed, and its membrana ia consisted of a condensation of the reticulum e niche; the perichondrium of the scala tympani ded over the inner surface of the membrana pro- tympani. A condensation of the peripherally located syncytium of the aqueduct was clearly seen as a continuation of a similar condensation of the dura-perichondrium of the posterior cerebral fossa. No free lumen or pouch was found in the aqueduct.

20. In another 4½ month old fetus (E.B.B.) the aqueduct measured 0.17 to 0.23 mm. by 1 mm. The condensation of the syncytial tissue reached a high

degree in this specimen, and the protoplasmic processes were no longer recognizable. In the center of this tissue there were one large and two small free lumens. In the large lumen a few cells were visible in reticular arrangement. The lumens could not be traced into the scala tympani and did not contain erythrocytes. Flat endothelium-like cells, such as lined the vein of the aqueduct in younger embryos, were missing in these lumens.

21. Within the aqueduct of a 130 mm. fetus (SA.130 L.) there was a clearcut differentiation into two different types of tissue: (1) a peripheral dense tissue, rich in cells, and (2) a centrally located loose areolated syncytial tissue. In the midst of the loose tissue several small and two larger lumens were seen; the center of the larger lumen was crossed by a network of areolated tissue. In another large lumen a great number of clumped small round cells were visible, the syncytial character of which was lost because of the dense arrangement of the cells. Both these cellular formations of the syncytium are frequent features of the adult aqueduct. Many capillaries filled with erythrocytes crossed the loose tissue, and some of them penetrated the free lacunas described. The cochlear vein was large and passed within the aqueduct into the scala. Formation of large tissue spaces (lacunas) was visible in the inner meningeal coating of the ninth nerve quite similar to the formation of the lacunas in the aqueduct. The resorption of the reticulum in the niche of the round window was far advanced. No vessels were found in the round window membrane, although the niche contained many. Extensive transformation of the cartilaginous walls of the aq into bone was progressing.

22. In the right ear of the same fetus (SA. 1 the aqueduct was 0.6 mm. wide at its narrowest p A dense dura-like tissue lined the aqueduct, center of which there was an area 0.2 to 0.3 mm. filled with syncytial tissue containing dark-st round nuclei. This tissue was identical with t ticulum seen in adult aqueducts (figs. 5 and 6). B of the fact that cartilage did not separate the aq from the niche of the round window at this st development, the dense dura-like lining of the aq went over directly into the round window mem The structure and the histogenesis of the window brane seemed to be similar to that of the outer lining the aqueduct. Two small vessels were ob in the membrana propria of the window mem

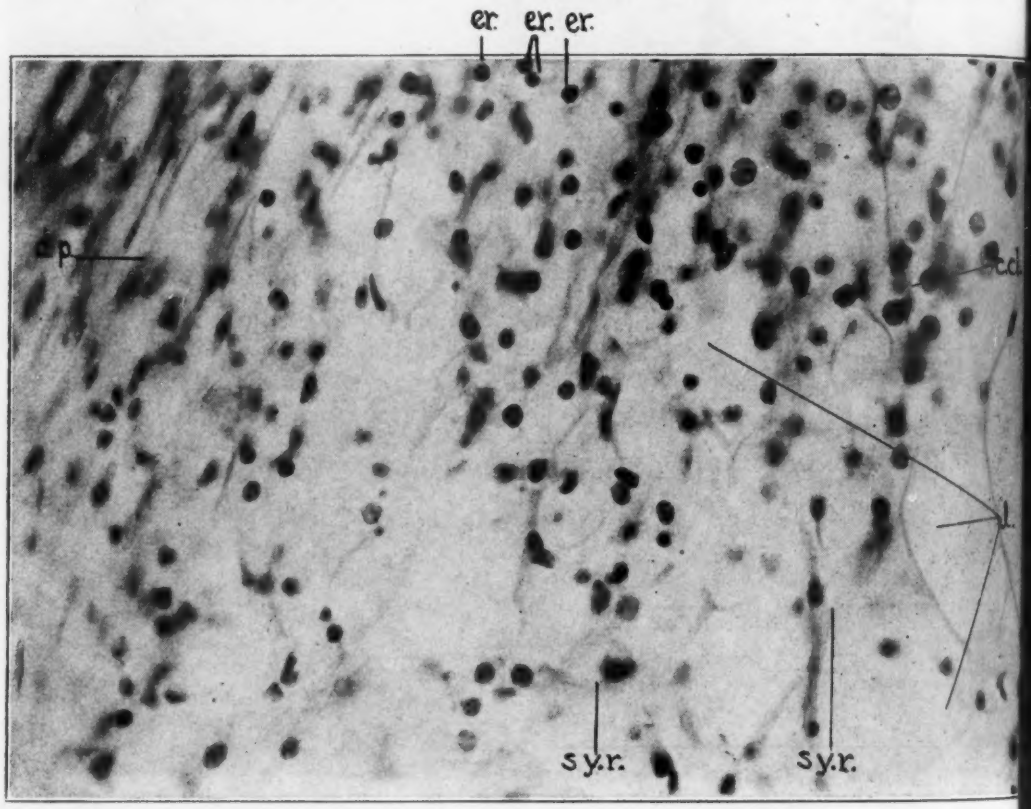


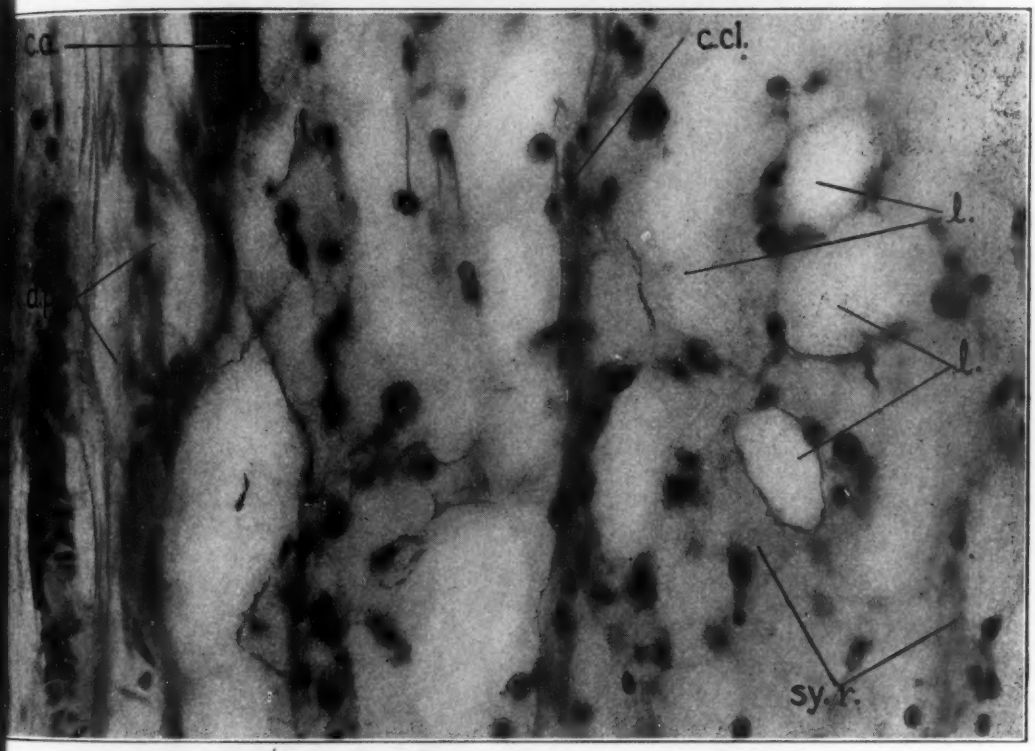
Fig. 5.—High power magnification of the reticulum in the cochlear aqueduct of a 130 mm. fetus. *d.p.* cates the dura-periosteum of the aqueduct; *sy.r.*, syncytial reticulum; *l.*, intercellular tissue space (lacu *c.cl.*, a cell cluster; *er.*, erythrocytes.

which were branches of vessels of the cochlear duct.

23. In a 130 mm. fetus (C.C. no. 1018) the w were injected with india ink, particles of which be found in the inferior petrosal sinus, in some bra of the cochlear vein and in many vessels of the of the round window. The aqueduct contained lumen which measured 1.33 by 0.25 to 0.14 mm. lumen was formed by a narrow layer of densely p elongated cells and did not communicate with the tympani. The syncytial tissue filling nine tenths aqueduct was similar to the loose reticulum of the so far as the cells were of the same type, but niche the intercellular spaces were larger. Fro somewhat pointed tips of these cells originated th

protoplasmic processes of the cells of the niche. were many vessels containing india ink in the ium of the niche but none in the round window rane itself.

In a 175 mm. fetus (SA. 175) the aqueduct was ht and measured 1.3 by 0.3 mm. At the level of anglion of the glossopharyngeal nerve it was 0.7 ide. It was completely filled with a moderately reticulum containing a great number of cell-free s. The large cochlear vein passed within this lum and could be traced into the scala tympani. ontinuous free lumen or canal was found. The window membrane consisted of densely packed el layers of elongated cells and measured 0.13 mm. dth. The niche was completely filled with loose lum, which contained many large vessels, while embrana propria showed only a few capillaries peripheral portion. There was a growing peri-



g. 6.—High power magnification of the reticulum in the cochlear aqueduct of a 43 year old man. Note imilar structure and arrangement of the syncytial cells in figures 5 and 6. *d.p.* indicates dura-periosteum e aqueduct; *sy.r.*, syncytial reticulum, *l.*, intercellular tissue spaces (lacunas); *c.cl.*, a cell cluster; *c.a.*, s amylaceum.

l bony septum which partially separated the niche the aqueduct. In the collection of the College of icians and Surgeons, periosteal bone first formed walls of the aqueduct in this specimen, and it ured on the average 0.12 to 0.18 mm. in width. periosteal layer of the cochlear labyrinthine cap- was the same width.

In a 180 mm. fetus (SA. 180 R) the aqueduct completely filled with mesenchymal tissue. The heral dura-like lining consisted of four to five lay- of closely packed elongated fusiform cells which arallel to each other and to the longitudinal axis e aqueduct. The central syncytium was identical the areolated tissue observed in adult aqueducts ontained in some places clumped small round dark- ing cells. There was no free lumen visible any- in the 130 mm. fetus. Many blood-filled capillaries were found in the niche; some of them reached the round window membrane, but only a few penetrated it. The few small vessels in the membrana propria were almost exclusively close to the insertion of the round window membrane into the bony frame (fig. 7).

26. In a 180 mm. fetus (SA 180 L.) the arachnoidal tube of the ninth nerve was seen as it entered in contact with the syncytium of the aqueduct. In the round window membrane there were a few capillaries. It was at this stage that bone first completely separated the cochlear aqueduct from the niche of the round window (figs. 7 and 8).

27 In a 5½ month old fetus (SA. 1926) the aqueduct was funnel shaped and measured 1.3 mm. in length and

0.2 mm. in width at its narrowest portion. The bony wall of the aqueduct was covered by a dense tissue composed of two to three layers of flat cells similar to the loose central syncytial cells. No continuous free lumen draining into the scala tympani was found. The cochlear vein was large and passed within the syncytium of the aqueduct, which in turn continued over into the dura-arachnoidal covering of the ninth nerve. The syncytial character. A few capillaries were pres the membrana propria, most of them being adjac its insertion line on the bony frame.

28. In a 200 mm. fetus (SA. 200) the aqueduct 0.3 mm. wide at its narrowest portion. A thin la dura-periosteum covered the bony walls of the aqu The centrally located syncytium was transformed a loose tissue in which the individual nuclei and p

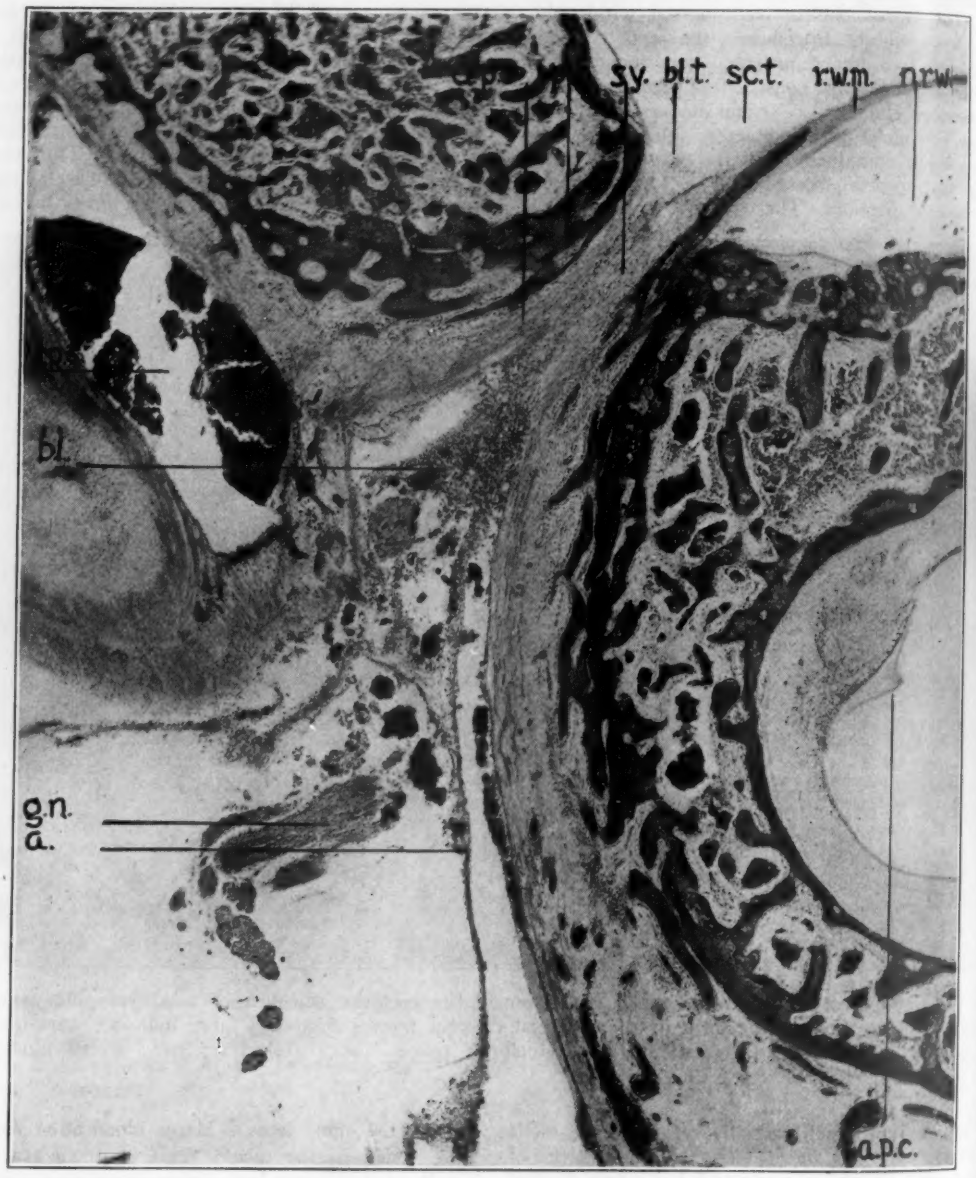


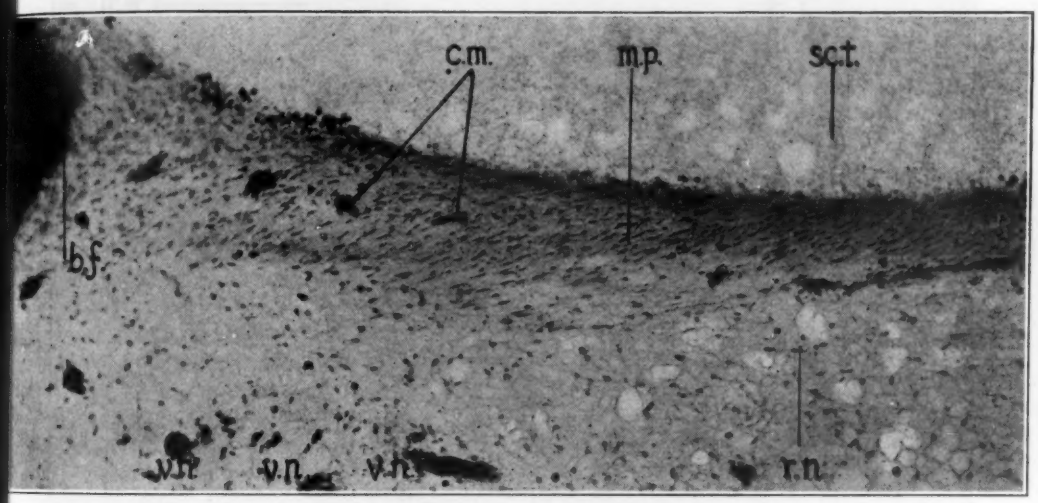
Fig. 7.—Cochlear aqueduct and round window membrane in a 180 mm. fetus, showing blood in the arachnoid space and in the opening of the aqueduct into the scala tympani. *d.p.* indicates dura-periosteum of aqueduct; *sy.*, syncytial reticulum; *p.b.*, periosteal bone of the aqueduct; *a.*, arachnoidea; *i.p.s.*, inferior petr sinus; *g.n.*, glossopharyngeal nerve; *sc.t.*, scala tympani; *r.w.m.*, round window membrane; *n.r.w.*, niche the round window; *bl.*, blood in subarachnoid space; *a.p.c.*, ampulla of the posterior semicircular canal; blood in scala tympani.

reticular tissue of the niche was rich in vessels and showed progressive resorption of the cells and formation of large tissue-free spaces (lacunas). The round window membrane, i. e. the membrana propria, almost reached its adult form and consisted of ten to fifteen layers of closely packed flat cells which had lost their plasmic processes were separated by tissue-free sp (lacunas) measuring 0.03 to 0.045 mm. in width. large blood-filled cochlear vein occupied one thir the aqueduct near its entrance into the scala tym The membrana propria of the round window mem consisted of eighteen to twenty parallel layers of de

ged elongated cells and measured 0.07 mm. in Vessels were found only in the peripheral loose n of the membrane.

In a 6 month old fetus (E. 2084) the cochlear uct measured 2.5 mm. in length and 0.4 mm. in and ran a straight course. The periosteal bony attained an additional broadening. Essentially ame spatial relationship existed between the peri- and the enchondral lining of the aqueduct in this as is present in the adult bone; the periosteal ing of the aqueduct and of the cochlear vein d the enchondral layer of the cochlea. The coch- vein appeared in a separate bony canal and was d 0.25 mm. medially in relation to the aqueduct. ree continuous lumen was found in the aqueduct, was there any space between the dura-periosteum he central reticular tissue. The periosteal lining e aqueduct consisted of densely packed elongated which stained paler with hematoxylin-eosin than entral syncytium, which formed an irregular re- m. The cells of this syncytium were small, round lark staining, and some of these cells which were are closely packed. The reticulum of the niche was now seen to be very loose, and the intercellular spaces attained a width of 0.05 mm. This reticulum was separated from the tympanic cavity by an epithelial covering. While the reticulum of the niche was rich in large engorged vessels, the membrana propria contained only a few capillaries, most of which ran parallel to the flat cells of the membrane itself.

31. In a 7 month old fetus (E.D.) the periosteal layer of the cochlear capsule was still thin; it measured 2 mm. in width. This determined the length of the cochlear aqueduct, which was 1.5 mm. long. The aqueduct was 0.35 mm. wide at its narrowest point, while at the ganglion of the ninth nerve it was 0.8 mm. wide. Half of the aqueduct was occupied by a dense dura-like tissue, the cells of which had elongated, fusiform, pale nuclei containing fine granules. The centrally located other half was filled with syncytial tissue containing deep blue-staining round nuclei. There was no separate continuous canal in the aqueduct inside the syncytium; there were many scattered small tissue-free spaces (lacunas). Several longitudinally running bands of



ig. 8.—Round window membrane and reticulum in the niche of the round window of a 180 mm. fetus. *m.p.*, brana propria of the round window membrane; *r.n.*, reticulum filling out the niche; *sc.t.*, scala tympani; capillaries of the membrana propria; *b.f.*, bony frame of the round window; *v.n.*, vessels in the niche.

ped together formed several longitudinally running s. These clumped cells were similar to the cell ers of the arachnoidea which one frequently ob- s elsewhere in the dura of adults. Many free s (lacunas) 0.05 to 0.04 mm. in width were visible st the syncytium, formed by resorption of the cells their protoplasmic processes; they represented the channel through which communication, if any, was ble between the scala tympani and the subarach- space.

The cochlear aqueduct on the opposite side of ame 6 month old fetus (E. 2084) showed a slightly rd curving course. The syncytium was heavily rated with erythrocytes, and some hemorrhage visible in the scala tympani near the opening of aqueduct. The membrana propria of the round ow membrane measured 0.08 mm. in width, which almost twice the thickness of the whole adult brane. The membrana propria consisted of ten to e parallel layers of flat spindle-shaped cells with dant intercellular spaces; in the adult these cells closely packed deep-staining cells crossed the syncytium. The boundaries between the outer dura-like and the inner arachnoidea-like tissue were clearcut on account of the different shape and staining qualities of the cells composing them; despite this, however, there was no subdural space between these tissues. The cochlear vein had a separate canal through the bony labyrinthine capsule. More than half of the loose reticulum of the niche had disappeared, and the remnant was separated from the tympanic cavity by a single layer of flat endothelium-like cells. A couple of capillaries were present in the layers of the membrana propria of the round window membrane and showed a course parallel to the flat cells of the membrane (fig. 9).

32. In a 3 day old infant (6252 L.) the aqueduct was 8 mm. long. It measured 0.6 mm. in width at its widest portion, 5 mm. from the scala tympani, and 0.07 mm. at its narrowest point, 1.7 mm. from the scala. There was no free lumen or canal in the syncytium, which occupied the central two thirds of the bony aqueduct. There were, however, a great number of small

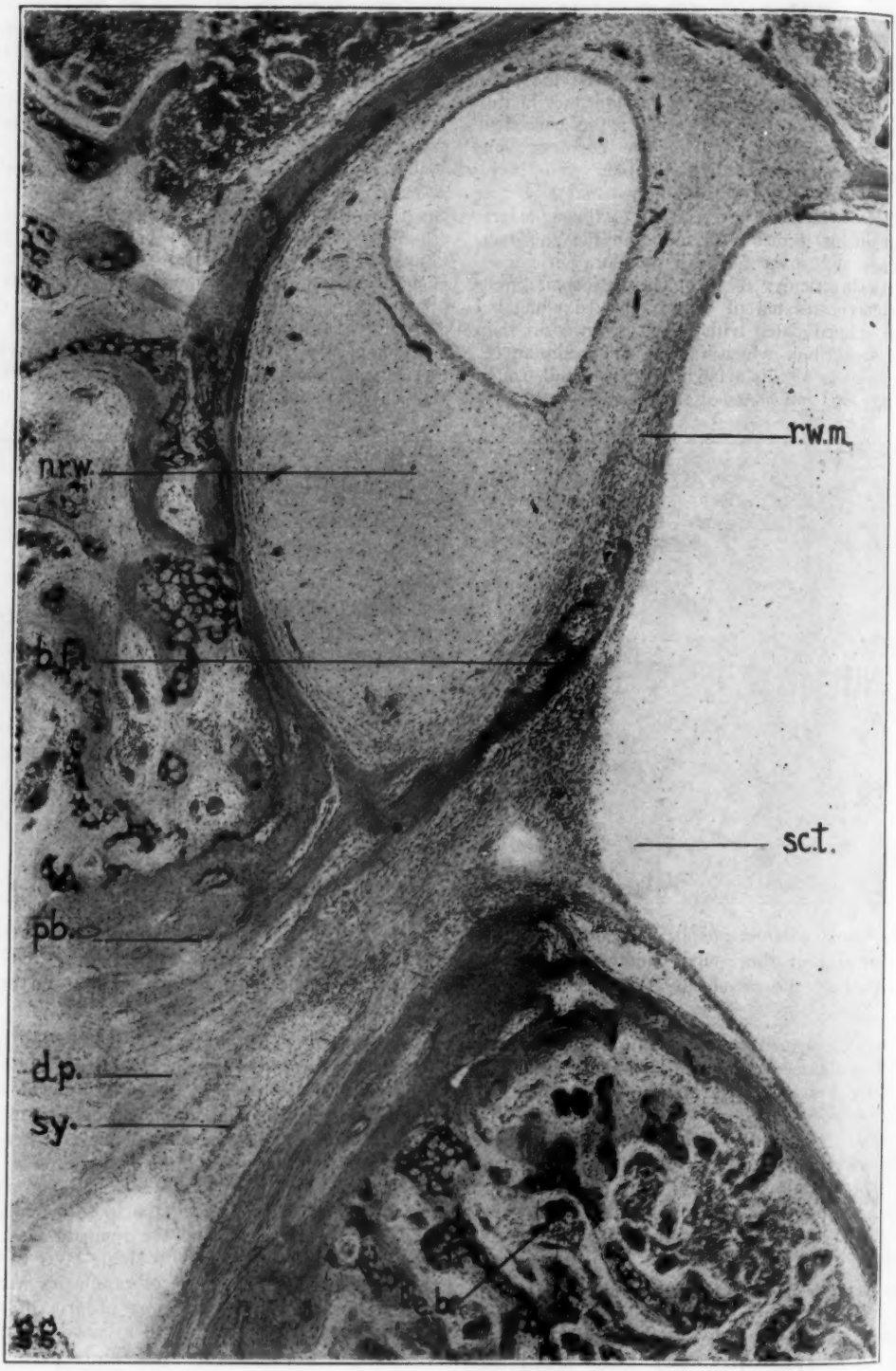


Fig. 9.—Cochlear aqueduct and round window membrane in a 7 month old fetus. There is no conti lumen in the aqueduct. *d.p.* indicates dura-periosteum of the aqueduct; *sy.*, syncytial reticulum; *p.b.*, peri bone of the aqueduct; *e.b.*, enchondral layer of the cochlea; *g.g.*, ganglion of the glossopharyngeal nerve; scala tympani; *r.w.m.*, round window membrane; *n.r.w.*, niche of the round window; *b.f.*, bony fram the round window membrane.

s, each of which could hold four to seven erythro- Vessels were found only in the peripheral dura- portion of the aqueduct. A subdural space was re observed. The width of the round window rane ranged from 0.07 to 0.13 mm. in its central n. A single layer of flat endosteal cells contain- ark-staining nuclei covered the inner surface of embrana propria. The inner half of the round w membrane was made of the dense fibrous mem- propria, in which the parallel arrangement of ongated cells was still recognizable. The outer as markedly looser and was covered by one to ayers of cuboidal epithelial cells. The outer half direct continuation of the mucosal covering of che of the round window. Vessels were found in uter or mucosal layer only. The niche was free senchyma.

In a 4 week old infant (A. 6200) the aqueduct red 7 mm. in length and 0.13 mm. in width at its west portion, which was located 1.3 mm. from cala tympani. Its course was essentially straight for a slight curving toward the petrous tip and rd. The soft parts in the wide portion of the uct were partially pulled out during autopsy. The l reticulum which filled out the aqueduct con- numerous small free spaces (lacunas) but no canal. Each of these lumens held five to ten rocytes up to the opening of the aqueduct into cala tympani. There was free blood in the scala ni just opposite the opening of the aqueduct. round window membrane was 0.08 to 0.11 mm. half of which was composed of the membrana ia, in which the individual flat fusiform cells were recognizable. A single layer of endothelium-like extended to the inner surface of the membrana ia, coming from the endosteum of the scala tym- The mucosal layer which occupied the outer half round window membrane consisted of one layer t cuboidal epithelial cells and loose subepithelial ctive tissue. The latter tissue was rich in vessels, none were found in the membrana propria.

COMMENT

he primordium of the cochlear aqueduct is al- y recognizable in an 18 mm. embryo in the of a circumscribed area of rarefaction in the rtilaginous otic capsule. Somewhat later a fferentiation takes place in the same area, in a 25 mm. embryo the aqueduct is repre- ed by a narrow gap in the otic capsule filled syncytial cells having long protoplasmic esses (fig. 1). The syncytium of this grow- gap is rich in vessels. Considering the poor ularization in the reticulum of the adult duct, one must conclude that this rich capil- system plays an important role in the rapid formation of the precartilage into embryonic ytial tissue. Similarly the formation of the ymphatic spaces of the cochlea progresses in presence of numerous capillaries. A 41 mm. embryo shows few capillaries in the aqueduct; the dedifferentiation of the precartilage and the cartilage into syncytium has been mostly accomplished by this time. The cells of the syncytium in the aqueduct and those forming the reticulum of the perilymphatic spaces of the cochlea show an obvious similarity (fig. 2). The dedifferentiation of the precartilage into syncytial tissue proceeds fastest on the outer perimeter of the otic capsule, probably because of the pressure exerted by the ganglion of the glossopharyngeal nerve.

Later, a condensation of the syncytial cells takes place along the cartilaginous walls of the aqueduct. These cells, containing no recognizable cytoplasm, become arranged in several parallel layers. This tendency toward peripheral condensation of the syncytial cells was recognizable in a 27 mm. embryo. In one 4½ month old fetus this peripheral tissue was clearly seen to be continuous with a tissue, similar in structure, which lined the posterior cerebral fossa, i. e., with the dura-periosteum (fig. 4). In a 130 mm. fetus and in older specimens the reticulum which composes the central portion of the aqueduct is identical in structure with the reticulum which fills out the adult aqueduct (figs. 5 and 6). Many embryonic histologic features are thus carried over into extrauterine life.

A continuous lumen connecting the subarachnoid space with the scala tympani is not present in fetuses or in infants up to four weeks of postnatal life. By partial resorption of the centrally located syncytial cells a large number of various-sized tissue spaces (lacunas) are formed (fig. 5) measuring 0.016 to 0.02 mm. in width in the 5½ month old fetus and 0.04 to 0.05 mm. in the 6 month old fetus. These small intercellular spaces seem to be the only mode of communication with the scala tympani. In proof of this fact, erythrocytes were found in the subarachnoid space surrounding the ninth cranial nerve and in the scala tympani just at the opening of the cochlear aqueduct in a 180 mm. (fig. 7) and a 6 month old fetus. No hemorrhage was evident elsewhere in the scala tympani. Similar evidence was observed in a 4 week old infant. The tubular pouch described by Streeter as the cochlear aqueduct in a 130 mm. fetus might have been the cochlear vein, which in its course passes inside the aqueduct. In the present series the cochlear vein first appeared in a separate bony canal in a 6 month old fetus. Up to this stage the vein enters the scala tympani, passing within the syncytium of the aqueduct. In a 37 mm. embryo the vein was clearly recognizable and its course traceable inside the scala tympani (figs. 2 and 3). If the pouch

described by previous authors were the aqueduct, one would expect to find a similar structure even more pronounced in its development in the older fetuses. An endothelium-like wall characterizes the vein in addition to its intracochlear course, while the numerous lacunas found in the syncytium of the aqueduct do not possess such a structure.

In some of the older fetuses the loose syncytium of the aqueduct is crossed by several bands of clumped, dark-staining round cells (fig. 5). These cells and their arrangement are similar to the arachnoidal cell clusters which are frequently observed in adults, especially along the great venous sinuses. This fact points again to a similarity of histogenesis between the syncytium of the aqueduct and the cells of the arachnoidea. It is probable that these cell clusters of the aqueduct undergo calcification later, in middle age, and form the so-called corpora amylacea (calcified concretions).

The intimate spatial relationship between the arachnoidea of the ninth nerve and the syncytium of the aqueduct was already evident in a 32 mm. embryo, in which they were directly continuous with each other. This relationship prevailed in a 54 mm. and an 85 mm. fetus (fig. 2). The formation of arachnoidal trabeculae around the ganglion of the glossopharyngeal nerve starts at approximately the time at which free intercellular tissue spaces (lacunas) appear in the loose syncytium of the aqueduct. (See the 130 mm. fetus.) The arachnoidal tube of the ninth nerve could be clearly traced into the widest portion of the aqueduct in several fetuses, and it entered in contact with the syncytium (figs. 2 and 7). A fluid exchange between the subarachnoid space and the scala tympani, in spite of the absence of a continuous lumen in the aqueduct, must take place through the intercellular lacunas of the syncytium.

In the earlier stages the aqueduct crosses the labyrinthine capsule in a straight line approximately at the level of the ampulla of the posterior vertical semicircular canal; in the later stages it shows a slight curving upward (cephalad). The funnel shape of the aqueduct was first indicated in a 22 mm. embryo, in which the outer perimeter of the otic capsule showed an indentation, probably due to the pressure of the ganglion of the ninth nerve. The ganglion is located higher or lower in the most inferior wide portion of the aqueduct, and this fact makes accurate measurements of the length of the aqueduct difficult. In this paper the length was always measured from the ganglion to the opening into the scala tympani. An increase in the length of the aqueduct is almost entirely due to apposition of perio bone to the posterior aspect of the petrous b therefore the aqueduct is short in intraut life (figs. 7 and 9). Great variations in le are observed because the periosteal bone its subject to wide variations. There seems to b regular progressive decrease in the width o aqueduct with age. There is, however, a ma decrease in width between the seventh fetal m and birth. After birth the aqueduct does not s marked change in width at its narrowest por it measures about 0.1 mm. in young infants.

In adults the cochlear aqueduct is surrou by a wedgelike mass of periosteal bone alon entire length up to its opening into the s tympani. This wedge naturally has to tra the enchondral layer of the cochlea. The ge of this island of periosteal bone may be well in its first stages in a 180 mm. fetus (fig. 7). this stage periosteal bone is being deposite the outer perimeter of the enchondral capsu the cochlea, and a direct continuation of th seen along the aqueduct. The periosteal rounding of the aqueduct enlarges together the apposition of periosteal bone to the post aspect of the labyrinthine capsule. It is evi that the same explanation is valid for the osteal canal of the cochlear vein which, passing within the aqueduct, is engulfed by same wedgelike periosteal bone.

The cochlear vein of the adult is freque formed by a ring of one layer of flat cells ha a protoplasmic process at each end resting thin basement membrane, and a loose retic connects it with the bony canal. A sim structure is found in older fetuses; e. g., in 6 months old the only difference was that perivascular reticulum was richer in cells. cochlear vein is considerably larger both in fetus and in the infant than any of the o vessels of the labyrinthine capsule.

The mesenchymal tissue filling the coch aqueduct bears a close relationship to the r window membrane. The development of round window membrane proceeds in a ma similar to that of the aqueduct. In the cartilaginous capsule a gap is first formed, w in turn is continuous with the reticulum of future niche of the round window. The l syncytium of the niche starts to show a conde tion of the cells in the area of the window m brane as early as the 27 mm. embryo. As condensation slowly progresses, the membr becomes thicker, while it still blends into loose syncytium of the niche in the 45 mm. bryo. In a 180 mm. fetus, although the elong

are arranged in dense parallel layers, the plasmic processes are still recognizable in und window membrane (fig. 8). The inner- layer of the membrane seems to be a con- tion of the perichondrium which lines the mphatic space of the cochlea. The devel- nt of the membrana propria of the round ow membrane is independent of the peri- m of its bony frame and precedes the forma- of the same. The periosteum appears later in the course of development than round window membrane. In a 6 month etus the membrana propria is twice the of that in an adult. This is due to the arrangement of the cells. In the present a newborn infant was the youngest speci- which showed a fully developed mucosal of the round window membrane, which at tage was considerably thicker than the adult

the meantime, the loose syncytium of the undergoes gradual rarefaction by enlarge- of its intercellular spaces to the extent his results in the formation of large lacunas ater in the disappearance of the tissue itself 4 and 7). In a 7 month old fetus half of iche was empty, and one layer of flat endo- m-like cells separated it from the tympanic (fig. 9). No reticulum was found in the of a newborn infant and several young s.

the earlier stages the mesenchyma of the uct, that of the round window and that tympanic cavity differ only in density of rrangement. The dura-like lining of the uct is in direct continuation with the simi- built membrane of the round window in 0 mm. and the 130 mm. fetus (fig. 4). The tium of the aqueduct is separated from the lum of the niche of the round window only dense dura-like layer of the aqueduct (fig. til about the fifth fetal month, when a thin steal bony pillar appears as a continuation bony wall of the aqueduct into the niche 7 and 9). This periosteal bone serves as nsertion point for the round window mem- and thus separates the niche from the uct.

s interesting to note the rich capillary supply niche of the round window in contrast with f the membrana propria, which is poor in ls. A small number or capillaries are in the rana propria of the 4 month old fetus. number increases somewhat with develop- and they are found in most cases in the neral portion of the membrane close to the insertion in the bony frame. The membrana propria is two to three times thicker at the inser- tion on the inner aspect of the promontory than at the insertion near the cochlear aqueduct, and the vascular supply is accordingly better in that location (fig. 8). Occasionally there are a few capillaries in the central portion of the mem- brana propria which run parallel to the flat cells of the membrane. Many of the larger vessels of the niche reach the membrane without entering it. The reticulum of the niche is still rich in vessels in a 7 month old fetus (fig. 9). In young infants only the mucosal layer of the round win- dow membrane contains vessels.

SUMMARY

The primordium of the cochlear aqueduct is first recognizable in an 18 mm. embryo.

The cochlear aqueduct develops by transfor- mation of the precartilaginous otic capsule into a syncytium, which at an early stage shows a dura-like condensation along the cartilaginous walls. The reticulum in the aqueduct of a 130 mm. or older fetus is more or less identical with that of an adult, and so the cochlear aqueduct shows many embryonic characteristics during adult life.

No freely communicating lumen is found between the subarachnoid space and the scala tympani up to four weeks postnatally. However, in 2 of the older fetuses and in a 4 week old in- fant, blood penetrated the scala tympani through numerous small lacunas. Such lacunas are formed by spotted resorption of the syncytium in the center of the aqueduct.

The arachnoidea and the dura surrounding the ninth cranial nerve were observed in several specimens to reach the syncytial tissue of the aqueduct. The cytologic changes in the aqueduct and in the meninges of the glossopharyngeal nerve are similar and occur at almost the same stage of embryonic development.

Cell clusters which are frequently seen in the loose syncytium of the aqueduct in older fetuses most probably are precursors of the so-called corpora amylacea (calcified bodies), which are almost standard features in the adult aqueduct.

In adults, periosteal bone surrounds the aque- duct as the latter crosses the enchondral layer of the cochlear capsule. Similar conditions already prevail in a 180 mm. fetus.

The vein of the cochlear aqueduct acquires a separate bony canal consisting of periosteal bone in the 6 month old fetus. Until this age it reaches the scala tympani by passing within the

syncytium of the aqueduct. The distance separating the vein from the aqueduct increases with age.

The course of the aqueduct is straight, and it is funnel shaped in the younger fetuses. Its lengthening is due to progressive apposition of periosteal bone to the labyrinthine capsule. The width of the bony aqueduct of the newborn infant at its narrowest point is approximately equal to that measured in adult bones.

The round window membrane develops by condensation of the loose syncytium of the niche. The histogenesis of the membrana prop identical with that of the dura-like lining aqueduct. It is in the fifth fetal month th niche is first separated from the aqueduct thin pillar of periosteal bone. The vascula ply of the membrana propria is poor, an few capillaries present are mainly seen cl the insertion line of the membrane in the frame. After the appearance of the m layer of the round window membrane h any vessels are observed in the membrana pr

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EARLY DIAGNOSIS AND ARREST OF OTOSCLEROSIS

(CLINICAL AND HISTOLOGIC OTOSCLEROSIS)

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d not choose the title for this paper. It ssigned to me, but I accepted it, because a challenge to state and face the facts and l something worth while to the present total lack of knowledge on these subjects. otologists know of no way to diagnose (subclinical) otosclerosis, no sure way to se early or late ankylosis of the stapedial te (clinical otosclerosis) and no way of the lesion. They possess little knowledge possible means of arresting it and have no of preventing its inheritance.

e chief reason for this state of affairs is that otosclerosis causes no deafness, and even sions cause no deafness unless they involve byrinthine windows sufficiently to impede bration of the stapes. In the absence of ss diagnosis of otosclerosis has been impos-

ly ankylosis of the stapes never begins in nular ligament or the round window mem- ; it begins in bone and occurs late in oto- sis, and when it occurs its effect on the g cannot be clearly differentiated from that d by other lesions that produce impedance. first discuss certain possibilities along these nd then consider whether an early diagnosis e reached by observations other than audi-

must be kept in mind that any and all types afness may precede or be superimposed on erosis, whether or not there is any ankylosis the otosclerotic lesions. If there are coinci- d auditory neural lesions, these are not diffi- o diagnose and measure, because they are ly characterized by a loss of hearing for conducted sound, and always by the pres- of what I have named the phenomenon of uitment." If there are lesions interfering middle ear conduction, these also are not ult to diagnose as such, but they are often ult to differentiate from ankylosis of the s causing conduction deafness.

Unfortunately, when a patient with otosclerosis first consults an otologist the lesion is in a late stage. Usually the deafness has, with slight variations, taken on one of the patterns shown in the accompanying chart.

None of the patterns is necessarily indicative of early otosclerosis or of early or late ankylosis of the stapes resulting from otosclerosis. *A* is frequently found with established uncomplicated otosclerosis; *B* and *C*, because of the added high tone losses, suggest obstructive deafness plus neural deafness, the latter with probably no relation to otosclerosis. These high tone losses would have been present even in the absence of any deafness from otosclerosis. The low and middle tone losses shown in these or similar graphs may be due to many types of obstructive deafness, but if there is a family history of otosclerosis and no prior history of trouble with the ear, and no otoscopic, pharyngoscopic or roentgenoscopic signs of past trouble with the ear, it is reasonable to infer that the deafness may be due to bony ankylosis of the stapes: However, even if all the signs point to past inflammatory episodes in the middle ear, the deafness in large part may nevertheless be due to bony ankylosis and not to imperfectly resolved past inflammatory episodes.

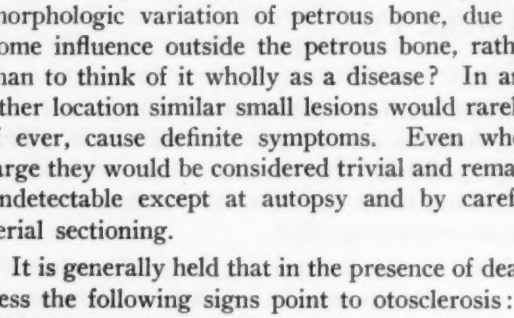
Another possibility complicates the picture: Interference with the metabolism and function of the stapes from vascular changes in and about the footplate in themselves may play a part in setting up or increasing a tendency toward otospongiosis in the parts involved. Several theories as to the cause of otosclerosis have been founded on such changes, but none has been convincing. That similar inflammatory phenomena do not cause lesions identical with otosclerosis elsewhere in the skeleton may be due to the unique structure of the otic capsule and its nervous and vascular systems.

Histopathology has as yet given no clue as to why otosclerosis was or was not set up in the specimens examined. Otosclerotic foci are found in persons with and without a family history of the disease and in all states of health and disease (frequently in the healthiest), with no

ad at the meeting of the Eastern Section of the can Laryngological, Rhinological and Otological y in Philadelphia, Jan. 12, 1945.

impressive etiologic correlations. In the white race 1 in 12 (8 per cent) harbor the lesions somewhere in the bone surrounding the inner ear (about a third of these have multiple lesions). Would it not, therefore, be almost permissible to think of early otosclerosis more as an unexplained morphologic variation of petrous bone, due to some influence outside the petrous bone, rather than to think of it wholly as a disease? In any other location similar small lesions would rarely, if ever, cause definite symptoms. Even when large they would be considered trivial and remain undetectable except at autopsy and by careful serial sectioning.

It is generally held that in the presence of deafness the following signs point to otosclerosis: a pinkish glow from the promontory, an apparent increase of hearing for bone-conducted sound, a positive Gellé test, immovability of the malleus,



Threshold curves commonly obtained in audiometric tests of hearing for air-conducted sound when patients with otosclerosis first consult an otologist: *A*, from girls and boys; *B*, from young adults. *C*, from older persons. The numbers of dots on the frequency ordinates above and below the plotted curve indicate the average degrees of uncertainty in plotting at different frequencies. Bone conduction is usually near normal for all frequencies except those above the middle range when the latter show considerable loss, as in curve *C*.

scantiness of cerumen, hairs and sweat in the external auditory canal, rarely exostoses in the external auditory canal except in swimmers, patency of the eustachian tubes, infrequency of colds in the head, a family history of otosclerosis and no personal prior history of aural disorders. But no one of these is pathognomonic, and even two or three of them are only suggestive of impending otosclerosis, in the absence of deafness. Even when all are present, they are of uncertain value. All of them may be absent in the presence of otosclerosis, and all of them may be present in the absence of otosclerosis.

However, if several of these signs appear in the presence of even a slight loss of hearing limited to the lowest tones, one should ex the patient intensively for signs of beg ankylosis. If the onset of deafness is coinc with or immediately follows puberty, child the menopause or metabolic disorders, the ability of otosclerosis is increased.

Careful observations compel me to discar old belief that menstruation affects the he of the patient with otosclerosis differently that of a patient with some other impe lesion of similar pattern and degree.

In the present state of knowledge, fro practical standpoint it is not the otoscleros se which is most important, it is the activi the lesion and the ankylosis. Without rec or sustained activity there is no ankylosis without ankylosis there is no deafness fro otosclerosis.

A study of Guild's [1] material (49 persons otosclerosis among 1,161 on whom routine a sies were made) shows that 7.55 per cent white people in his material harbored otoscl but that only about 1 per cent had ank (clinical otosclerosis). Had the white fe been in the same proportion as the male the incidence of ankylosis unchanged, G data would have been expected to reveal 8 per cent of white persons with otoscle and only 1.16 per cent with ankylosis o stapes. Only about 1 in 7, or 14 per ce white people with otosclerosis, would have s ankylosis. The number of Negroes was not cient to use for calculation of the percen These figures give one food for thought. mean that there are about 10,100,000 peop the United States (of the white and other r with otosclerosis (this is higher than some mer estimates) and that about 1,500,000 of are suffering from deafness (ankylosis) d that condition. In other words, only about 7 of those harboring otosclerosis lose much ing because of it. (This is many times less some former estimates.)

With regard to white people with otoscle Guild's data show that at death one half of males and females had no active lesions. means that sex alone was not a major fact the incidence of activity and may be, there not a major etiologic factor in spite of the that twice as many females as males harbo lesion. In the few Negroes with otosclerosis the incidence of active lesions was much hi than in white persons, but the incidence of sclerosis was much less (about 1 per cent).

1. Guild, S. R.: Histologic Otosclerosis, Ann. Rhin. & Laryng. **53**:246 (June) 1944.

ts some racial, inheritance or environmen-
tor of major importance.

at are the reasons for the large differences
idence in the sexes, the races and the age
s and in bilaterality? When otologists
it will be possible to understand the prob-
etter. But as yet they do not know. They
ly pick up a piece of information here and
and carefully try to put it into one of the
vacant spaces in the present picture. I
lo this with a few observations which to me
st possible leads for investigation.

the first place, in my opinion examiners
l stress people as well as ears, because the
rs of any person have the same background
eritance and, much of the time, of environ-
(even as identical twins). However, about
d of the people with histologic otosclerosis
th show unilateral lesions. This observa-
trongly suggests a local anatomic or patho-
logic etiologic factor. I have observed in
ns with unilateral clinical otosclerosis that
dition to the unilateral deafness there are
imes observable two or more of the non-
ry signs which I mentioned as frequently
panying otosclerotic deafness limited to, or
pronounced on, the side of the deafened
When they occur in such a patient the signs
n my opinion useful aids in the diagnosis
sclerosis, because I have less often observed
in persons with progressive unilateral deaf-
rom frank nonotosclerotic lesions. In every
one should look for and record such obser-
ns until a sufficient number have been
ed to constitute a more definite implica-
Many differential diagnostic criteria in
fields of medicine are founded on evidence
ore suggestive.

the second place one should stress the inci-
of inactivity and activity at different periods
in the two sexes.

hough only one half of the people with
erosis showed active lesions at the time of
sy,[1] in every one there had been active
ds, as otherwise the lesion would not have
d or would have remained only a micro-
focus, not encroaching on any other part
bone.

ild's data show that in white males with
erosis the lowest incidence of activity of
tosclerotic lesions was in those who died
60 years of age. In 113 instances (the loca-
of the lesion being disregarded and the
grouped into twenty year periods) active
uiescent areas were distributed as follows:
ose under 20, 15 active and 2 quiescent;
20 to 39, 14 active and 15 quiescent; 40 to 59, 27 active and 22 quiescent; 60 plus, 2 active and 16 quiescent.[2]

In females the lowest incidence of activity was in the age group (7) who died between the ages of 28 and 44 (in 5 of the 7 all lesions were inactive). Of the 5 females younger than 28, all but 1 showed active lesions. In the same ear one lesion may be active and another inactive. Even in a single lesion activity varies in different locations. Some of this suggests etiologic factors coincidental with, if not related to, hormonal imbalance, and nowadays there are available several potent medicines with which to regulate and normalize these disorders.

In the third place otologists should stress the ankylosis, because ankylosis is the cause of the deafness, and it can be measured quantitatively during life. Ankylosis has usually been found accompanied by activity in the lesion. The variations in its incidence at different ages mean something. Its early detection is imperative for successful arrestive treatment. In Guild's material there was no ankylosis of the stapes in any one who died before the age of 44. In this connection it must be remembered that the incidence of activity, of ankylosis and even of otosclerosis itself may be much greater (or vice versa) in well people generally than in the material studied by Guild from sick people who died.

The only impressive sign which otologists now have of beginning ankylosis is a slight lowering of hearing for the lower frequencies.

The typical audiometric curve of the patient with uncomplicated active otosclerotic ankylosis shows a loss of hearing which progresses inversely with frequency (chart). What does this mean? It means that for the tones below 1024 double vibrations per second or thereabout there is more and more loss as one goes down the scale of frequency (and this loss increases with time), so that beginning at the very lowest frequency sensed as a pure tone (16 double vibrations) the loss is generally less and less with each higher octave (sometimes even with each one-half, one-third or one-fourth octave).

Few persons go through life without some inflammatory episodes in their middle ears and the spaces adjacent thereto, so that many persons with otosclerosis have adhesions about the stapes. In spite of this, the statement "loss progressing inversely with frequency" generally holds true, because otitis media, even severe otitis media, unless it is recurrent, usually resolves with little

2. Guild, S. R.: Personal communication to the author.

if any loss of hearing. In youth this is usual, but later in life complete functional recoveries from severe or repeated otitis media are less frequent, and losses may appear to resemble those of increasing ankylosis. (Bony ankylosis never resolves.)

Otologists seldom have the opportunity of examining a person both before and just after beginning ankylosis supervenes. If one does have this opportunity, is it possible to detect threatening or beginning ankylosis? I have herein suggested one possible approach to the problem, and in 1936 I suggested another approach,[3] the "Hobble test," but the small changes in sensitivity to low tones involved in this test make it difficult, and I have been unable as yet to simplify it.

There are certain other observations which may prove to be of use. One is that the two ears should be compared with each other instead of with the average normal ear to detect beginning otosclerotic changes, as one ear always precedes and differs somewhat from its fellow in its early symptoms and early lesions. Another is that there is sometimes more uncertainty in a threshold determination in the presence of beginning ankylosis than in that of beginning impedance from other causes. Another is that in an ear with what appears to be beginning otosclerotic ankylosis there is frequently observable to the patient a change in the quality of the pure tone at a critical intensity above threshold. Similar changes in the normal ear have been reported by Mr. R. L. Wegel and by myself,[4] but at large distances from threshold. I have reported them also in an ear with ankylosis.[4] In this ear with typical clinical otosclerosis the changes occurred nearer threshold than in normal ears. Still other differences have been observed, and any and all of these are well worth further study as possible aids in the early diagnosis of ankylosis.

What about the claim that the fistula operation arrests otosclerosis? There is no impressive evidence that the operation arrests the lesion. It does in some instances and for varying p improve the hearing considerably, but th occur irrespective of any change in the a of the otosclerosis. The fact that one has o and can pass in and out of one door of a does not mean that the causes preventing another door have been influenced there any way.

In attempting to make a diagnosis of otos sis in the absence of deafness there are no tive criteria for guidance. However, I su the following approach to the problem: child should be carefully examined otolog when it enters school. A history of progre deafness in the family should lead the s observer to examine the child more frequ and to institute measures to correct any a malities.

With regard to the children of famili which otosclerosis has occurred, I stres necessity of comprehensive otologic examin beginning before puberty and including m and laboratory observations even if the chi show no deafness. Interest is centered o hormonal and harmonal factors and on c vitamins and minerals. Irrespective of otos sis, these are of special importance at this of life. A few parents have followed my ad and in none of their children has deafnes veloped. Many more such children will ha be treated before otologists will be in a po to state with any assurance that the proce advised surely have preventive or arrestive va

In my opinion the failure to detect diso related to hormones, vitamins and minera many cases of established clinical otoscler due to the lateness of the examination. disorder or disease originally present has few exceptions largely disappeared befor otologist sees the patient, and its occur cannot then be clearly established or even pected.

It is evident that I have not set up any cle criteria for the early diagnosis or arrest of sclerosis. However, if I have convinced one that the patient should not be negle that the lesion can and in the majority o stances does become inactive at various pe of life even without treatment and that he sh help nature in her efforts to arrest otoscler I shall not have wasted my time or the reader

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CEPTOR APPARATUS OF THE VESTIBULOVASOMOTOR REACTION

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hile the receptor apparatus of the labyrinth es on the skeletal and the ocular muscles een studied in much detail, there is a lack of information regarding the labyrinthine re- on the vegetative nervous system. Since tter reflexes form an essential part of the us types of sickness caused by motion, it d desirable to study this problem. As a step, the vasomotor reaction induced by nthine stimulation was chosen, the central he effector mechanism of this reaction hav- been analyzed previously (Spiegel and triades [1]).

e starting point of these experiments was uliar observation that at first glance seemed reement with the theory proposed by Quix [2] seasickness is caused by stimulation of the hic apparatus. In cats in which for other ns bilateral puncture of the round windows een performed (Spiegel and Scala [3]) rota- ailed to produce a postrotatory nystagmus. ever, such stimulation was still able to elicit a fall of blood pressure (fig. 1). Considering that rotation may act not only on the cristae ampullares but also on the utricles (Maxwell [4]; McNally and Tait [5]), particularly when rapid acceleration occurs, the possibility presented itself that the vasomotor reaction accompanying labyrinthine stimulation may originate in the otolithic apparatus.

EXPERIMENTS

The effect of labyrinthine stimulation on the blood pressure was studied in guinea pigs after the animals had been centrifuged in order to throw the otoliths off the maculas (Wittmaack [6]) and to abolish, for some time at least, the tonic labyrinthine reflexes (Magnus and deKleijn [7]). Since the tonic labyrinthine reflexes may reappear after the otolithic membranes have been thrown off the maculas (deKleijn and Versteegh [8]; Hasegawa [9]), the vasomotor reaction to laby-

om the Departments of Physiology and Experi- l Neurology, Temple University School of Medi- Philadelphia (Drs. Oppenheimer, Wycis and el), and the Department of Surgery (Otolaryn- y), University of Chicago (Dr. Lindsay).

e experimental part of this study was carried out a contract, recommended by the Committee on al Research, between the Office of Scientific Re- and Development and Temple University. See inary note by E. A. Spiegel, M. J. Oppenheimer . T. Wycis (The Receptor Mechanism of Vestib- omotor Reactions Induced by Rotation, Feder- Proc. **3**:44, 1944).

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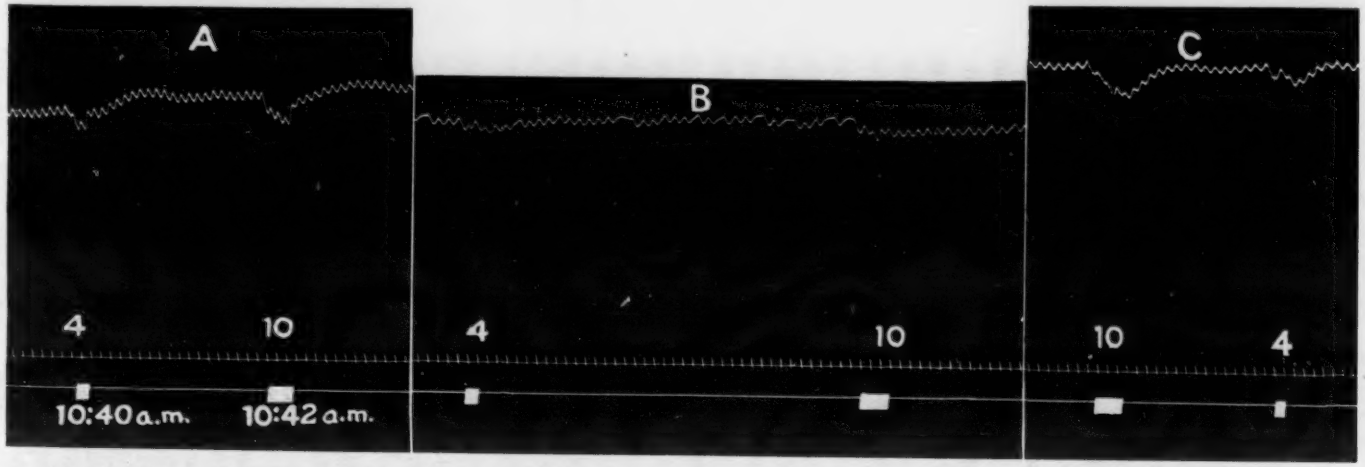


Fig. 1.—Manometric record of the effect of rotation on the blood pressure of a cat in which both round windows had been punctured on April 19, 1943. The record, made on April 20, with no postrotatory nystagmus present, shows: *A*, effect of four and ten rotations about the horizontal axis after the cat had been anesthetized with pentobarbital sodium (35 mg. per kilogram); *B*, effect of four and ten rotations one-half hour after a 2 per cent solution of cocaine in 80 per cent alcohol had been injected through both round windows; *C*, effect of four and ten rotations three hours later.

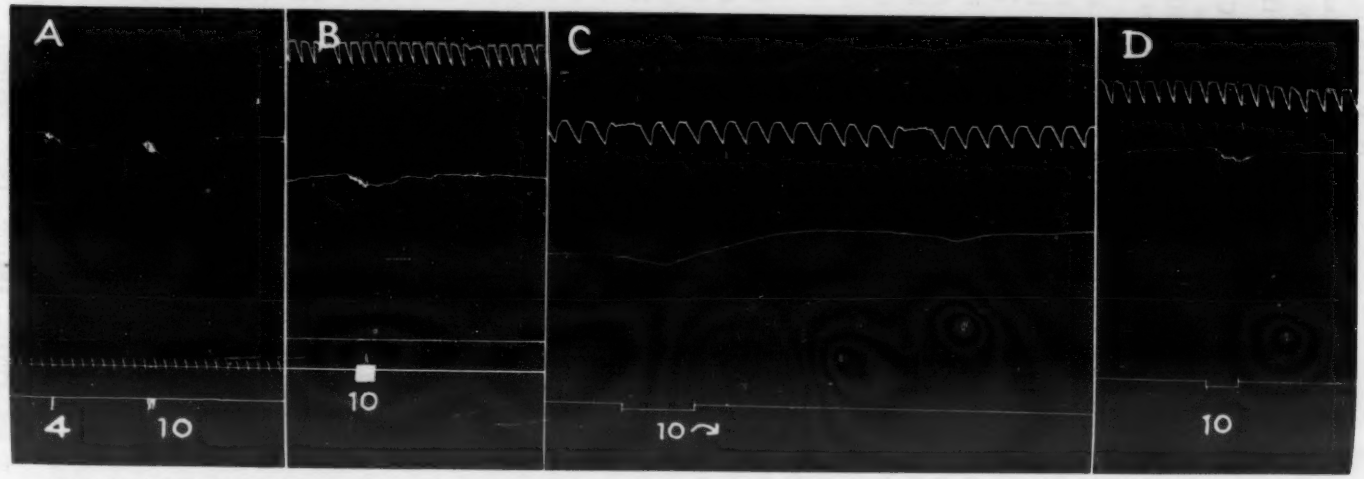


Fig. 2.—Effect of rotation on the blood pressure of heparinized guinea pigs after centrifugation. The animals were anesthetized with 0.2 cc. of pentobarbital sodium and ether before centrifugation. *A*, effect of four and ten rotations

ne stimulation was tested at a stage in the tonic labyrinthine reflexes were absent.

blood pressure was recorded from the carotid while the animals were under pentobarbital so- ether anesthesia. In order to prevent clotting in erial cannula, the guinea pigs were heparinized.

LE 1.—*Labyrinthine Reflexes of Guinea Pig 4*

	Before Centrifugation	After Centrifugation
Durations of Postrotatory Nystagmus, in Seconds		
ng 10 rotations to right	7	3½
ng 10 rotations to left..	5½	0
Reflexes on Linear Acceleration		
	Before Centrifugation	After Centrifugation
n of head at end of d movement.....	+	+
n of head at begin- f downward movement	+	Weak
g of toes on abrupt ard movement.....	+	+
s to jump.....	+	—
Positional Reflexes		
	Before Centrifugation	After Centrifugation
of head:		
right side position.....	+	—
left side position.....	+	—
trunk vertical up.....	+	—
trunk vertical down....	+	—
supine position.....	+	—
satory eye movements:		
ht side position.....	+	—
t side position.....	+	—

were rotated either about the longitudinal axis body, which coincided with the longitudinal axis animal board, or about a vertical axis correspond- the dorsoventral axis of the animal. In both es the blood pressure was recorded during all of rotation, an arrangement previously described used (Spiegel and Démétriades[1]). In the ion of the axis of rotation, a glass tube was fixed as connected to the recording manometer. Within be, a second, closely fitting tube rotated that nnected to the carotid artery. As a rule, the ns to four and ten rotations were studied (average f "slow" rotation, about 1.5 seconds per rotation; "fast" rotation, about 0.8 second per rotation).

short description of representative experi- follows.

NEA PIG 4 (weight, 390 Gm.).—On June 30, 1943, 25 a. m. the animal, under ether anesthesia, was ed to centrifugation for two minutes at 1,200 ns per minute; it lay in a side position at a right to the radius of the centrifuge, with its caudal the direction of rotation; at 10:45 it was centri- for one minute at 1,100 rotations per minute and 3 for one and one-half minutes at 1,200 rotations nute. At 11:17 the animal showed hemorrhage right conjunctival sac and transitory spontaneous y nystagmus, with the fast component caudad. rotation about the horizontal axis, there was a fall of blood pressure during and following four and ten rotations, wtih slow and with quick rotation (fig. 2 *A*).

Examination of Labyrinthine Reflexes.—The observations are outlined in table 1.

Examination of the Ears.—Right Ear: The middle ear had undergone moderate hemorrhage, the blood being free in the cavity and submucosal. The vestibule showed slight hemorrhage and advanced postmortem degeneration. The utricle was of normal contour. The macula had undergone marked postmortem degeneration. The otolithic membrane was raised and mostly detached (fig. 3 *A*). The saccule was of normal contour. The macula showed much postmortem degeneration with the otolithic membrane partly detached. In the semicircular canals there was no hemorrhage. Good contour was noted at the ampullae. Postmortem degeneration was advanced. The cupulae were absent. The cochlea showed no hemorrhage but had undergone marked postmortem degeneration.

Left Ear: The middle ear disclosed slight hemorrhage. The vestibule showed no hemorrhage; postmortem degeneration was moderate. In the utricle the otolithic membrane was detached completely. In the saccule the otolithic membrane was raised, partly separated and partly detached (fig. 3 *B*). The semicircular canals showed no hemorrhage. There was some distortion of contour of the membranous ampullae.

Table 2.—Labyrinthine Reflexes of Guinea Pig 8

	Before Centrifugation	After Centrifugation
Duration of Postrotatory Nystagmus, in Seconds		
After 10 rotations to right....	7	7
After 10 rotations to left.....	5	6
Reflexes on Linear Acceleration		
	Before Centrifugation	After Centrifugation
Elevation of head at end of upward movement.....	+	—
Elevation of head at beginning of downward movement.....	+	—
Spreading of toes on abrupt downward movement.....	+	—
Readiness to jump.....	+	—
Positional Reflexes		
	Before Centrifugation	After Centrifugation
Righting of head:		
From right side position.....	+	—
From left side position.....	+	—
With trunk vertical up.....	+	—
With trunk vertical down....	+	—
From supine position.....	+	—
Compensatory eye movements:		
In right side position.....	+	—
In left side position.....	+	—

The postmortem degeneration was graded 3 plus. The cochlea disclosed no hemorrhage. The postmortem degeneration was moderate (2 plus).

Summary and Correlation of Experimental and Histologic Observations.—Tonic reflexes were absent after centrifugation; the reflexes on linear acceleration were partly preserved. The otolithic membranes were partly detached. The absence of postrotatory nystagmus following rotation to the left apparently was due to the absence of the right cupulae. The vasomotor reaction was preserved.

Fig. 2.—Effect of rotation on the blood pressure of heparinized guinea pigs after centrifugation. The animals were anesthetized with pentobarbital sodium and ether before centrifugation.

GUINEA PIG 8 (weight, 435 Gm.).—On Sept. 14, 1943, at 9:52 a. m. the animal, under ether anesthesia, was subjected to centrifugation for one minute at 1,500 rotations per minute. The position during centrifugation was as described for guinea pig 4. Following centrifugation the animal showed tremor of the head and transient nystagmus; the head was held slightly obliquely, the right ear being lower than the left.

On rotation about the horizontal axis there was a definite fall of blood pressure only after 10 fast rotations (fig. 2 *B*).

substance appeared to be present but plastered d the sensory epithelium. In the cochlea, R membrane was depressed. The hair cells were vi

Left Ear: The middle ear disclosed moderate rhage, with blood free in the cavity and sub The vestibule showed moderate hemorrhage an postmortem degeneration. In the utricle the membrane was detached (fig. 5 *A*). In the sacc otolithic membrane was detached (fig. 5 *B*). semicircular canals there was some distortion ampullae of the horizontal and 'superior ca

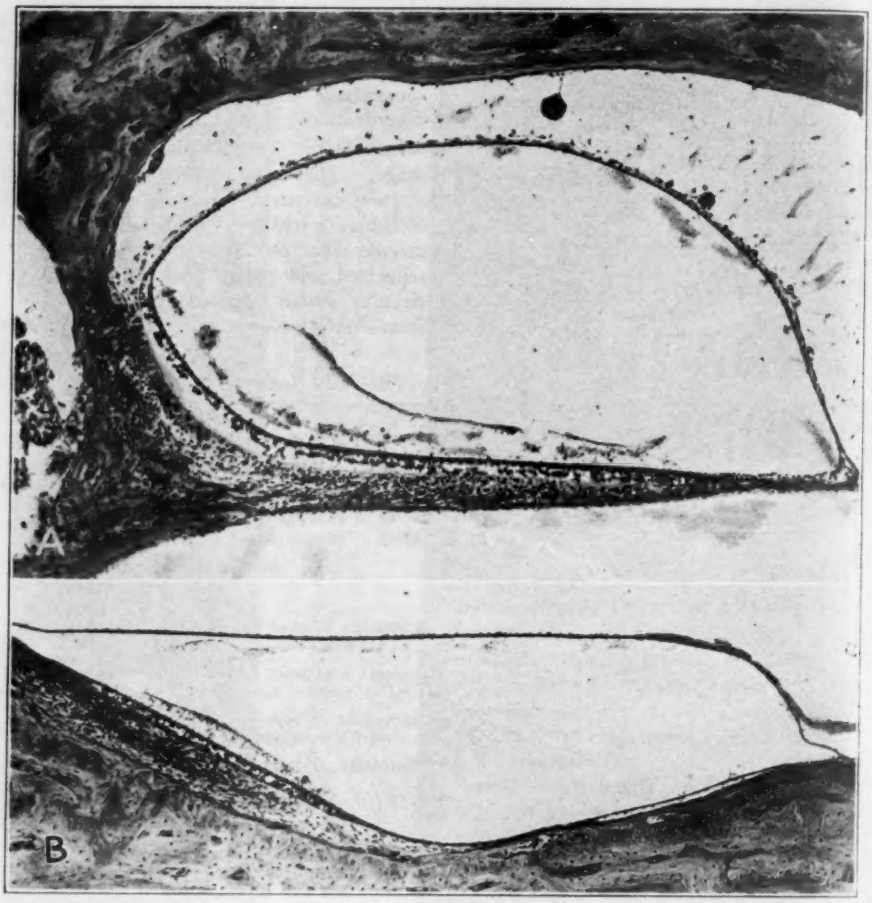


Fig. 3 (guinea pig 4).—*A*, section through the utricular macula of the right ear. The otolithic membr detached and raised. Postmortem degeneration is advanced. *B*, section through the saccular macula of t ear. The otolithic membrane is raised but not thrown off. Moderate postmortem degenerative changes are in the macula.

Examination of Labyrinthine Reflexes.—The observations are outlined in table 2.

Examination of the Ears.—Right Ear: The middle ear showed moderate hemorrhage. The vestibule showed slight hemorrhage. There was probably early postmortem degeneration of the sensory epithelium. In the utricle the otolithic membrane was detached and lying near the common crus in the posterior canal (figs. 4 *A* and *B*). In the saccule the otolithic membrane was detached (as if it had slid off the macula) (fig. 4 *C*). In the semicircular canals, the ampullary walls showed distortion, but there was no hemorrhage. The cupular hemorrhage. The cupulae were present in all (fig. 6 *A* and *B*). In the cochlea, Reissner's me was depressed. The cochlea was fractured open tip (apparently before fixation).

Summary and Correlation of Histologic and E mental Observations.— Following centrifugation sitional reflexes and reflexes on linear acceleration lost, but postrotatory nystagmus could be elicite fall of blood pressure could be produced by rotations about the horizontal axis. Histologic e nation revealed that the otolithic membranes we tached and the cupulae preserved.

EA PIG 10.—On Oct. 12, 1943, at 3 p. m. the under ether anesthesia, was subjected to cen- ion for one minute at 1,500 revolutions per During centrifugation the animal lay at a right o the axis of the centrifuge, in a prone position. tober 13 at 10 a. m. the animal was tested. The as tilted to the left; there was slight tremor head.

stinct, although slight, fall of blood pressure was by 10 rotations about the vertical axis, with a ry rise (fig. 2 *C*).

ination of Labyrinthine Reflexes.—The observa- are outlined in table 3.

TABLE 3.—*Labyrinthine Reflexes in Guinea Pig 10*

Duration of Postrotatory Nystagmus, in Seconds	Before Centrifugation	After Centrifugation
Following 10 rotations to right	9	7
Following 10 rotations to left..	10	8
Reflexes on Linear Acceleration		
	Before Centrifugation	After Centrifugation
Elevation of head at end of upward movement.....	+	Weak +
Elevation of head at beginning of downward movement.....	Weak +	—
Spreading of toes on abrupt downward movement.....	+	Very slight
Readiness to jump.....	Weak +	—
Positional Reflexes		
	Before Centrifugation	After Centrifugation
Righting of head:		
From right side position.....	+	—
From left side position.....	+	—
With trunk vertical up.....	+	—
With trunk vertical down....	+	—
From supine position.....	+	—
Compensatory eye movements:		
In right side position.....	+	Slightly +
In left side position.....	+	—

4 (right ear of guinea pig 8).—*A*, section through terior semicircular canal near the common crus, g the detached otolithic membrane lying within nen. *B*, section through the utricle showing the ic membrane absent from the macula. *C*, section h the saccule showing the otolithic membrane ed from the macula.

mination of the Ears.—Right Ear: The middle owed slight hemorrhage. The vestibule showed norrhage; there was slight postmortem degener- In the utricle the otolithic membrane was dis- and lying in the ampulla of the superior canal *A* and *B*). In the saccule the otolithic membrane was present for the most part but abnormal (fig. 7 *C*). The semicircular canals revealed no hemorrhage. There was some distortion of the ampullary walls. The cupulae in the horizontal and superior canals were visible but that in the posterior canal was absent. The cochlea was normal except for early postmortem degeneration.

Left Ear: The middle ear showed slight hemorrhage. The vestibule revealed no hemorrhage. The utricle had undergone slight postmortem degeneration; the otolithic membrane was mostly detached (fig. 8 *A*). In the saccule the otolithic membrane was mostly detached

TABLE 4.—*Labyrinthine Reflexes in Guinea Pig 11*

Duration of Postrotatory Nystagmus, in Seconds	Before Centrifugation	After Centrifugation
Following 10 rotations to right	7	0
Following 10 rotations to left..	8	10-11
Reflexes on Linear Acceleration		
	Before Centrifugation	After Centrifugation
Elevation of head at end of upward movement.....	+	—
Elevation of head at beginning of downward movement.....	+	—
Spreading of toes on abrupt downward movement.....	+	—
Readiness to jump.....	+	—
Positional Reflexes		
	Before Centrifugation	After Centrifugation
Righting of head:		
From right side position.....	+	—
From left side position.....	+	—
With trunk vertical down....	+	—
With trunk vertical up.....	+	—
From supine position.....	+	—
Compensatory eye movements:		
In right side position.....	+	—
In left side position.....	+	—

(fig. 8 *B*). The semicircular canals showed no hemorrhage or distortion. The cupula of the horizontal canal was present, that of the superior was partly present and that of the posterior canal was absent. The cochlea showed signs of early postmortem degeneration. Reissner's membrane was partly depressed and in contact over the tectorial membrane and Corti's organ.

Summary and Correlation of Experimental and Histologic Observations.—After centrifugation all positional reflexes were absent except compensatory ocular movements with the right side position. On linear acceleration the reflexes were partly preserved. The otolithic membranes were not quite completely detached. The presence of cupulae in the horizontal canals is in agreement with the observation of postrotatory nystagmus on rotation about a vertical axis. A vasomotor reaction on rotation about the vertical axis was present.

Guinea Pig 11 (weight, 460 Gm.)—On Nov. 2, 1943, at 5 p. m. this animal was centrifuged under the same conditions as guinea pig 10 at 1,500 revolutio minute for one minute. It was tested Novembe 10 a. m. The head was spontaneously rotated left so that the left ear lay lower than the right was slight tremor of the head; occasionally thi spontaneous nystagmus to the right.

With respect to blood pressure, on rotation a vertical axis there was a depressor reaction (fig more marked on rotation to the left than on rota the right.

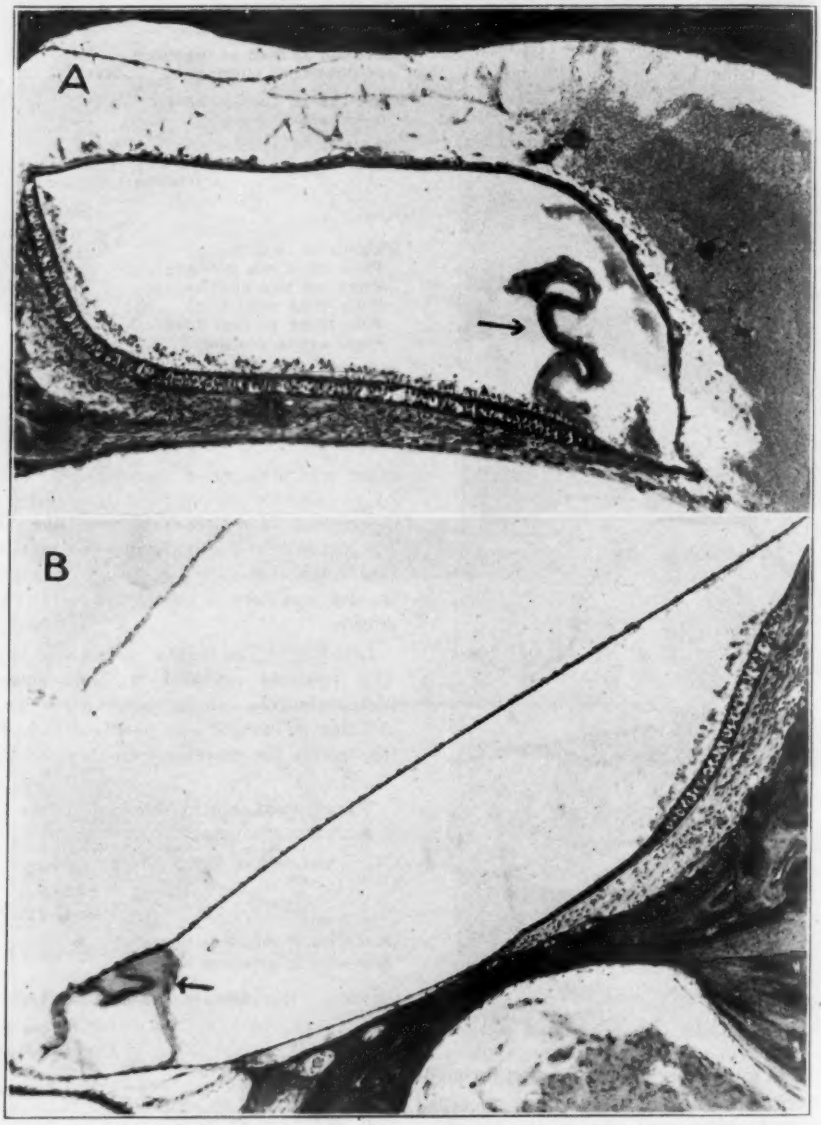


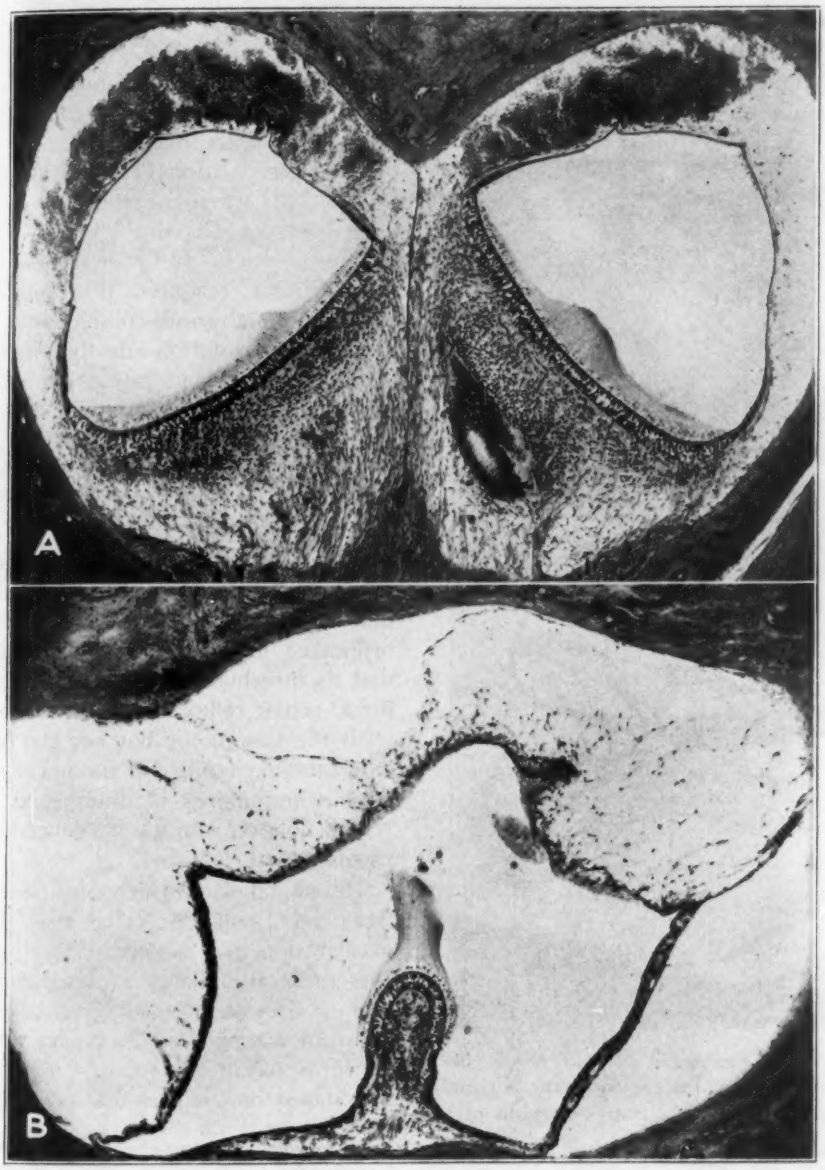
Fig. 5 (left ear of guinea pig 8).—*A*, section through the utricle showing the otolithic membrane de *B*, section through the saccule showing the otolithic membrane detached and displaced.

Examination of Labyrinthine Reflexes.—The ob tions are outlined in table 4.

Examination of the Ears.—Left Ear: The ear showed slight hemorrhage. The vestibule s slight hemorrhage in the perilymphatic space, slight postmortem degeneration. In the utricle an saccule the otolithic membrane was detached (fig and *B*). In the semicircular canals there was distortion of the ampulla of the superior canal by h

The cupula of the posterior canal was in place, the superior canal was partly visible and that of rizontal canal was not seen. In the cochlea there emorrhage (4 plus). The capsule of the cochlea ractured. Degeneration was very slight. (The rhage appears to have followed the fracture but e preceded fixation, suggesting fracture of the tip instrument which punctured the drum to admit e.)

distorting the cupula (figs. 10 *A* and *B*). In the saccule the otolithic membrane was detached (fig. 10 *C*). In the semicircular canals the ampullary walls were greatly distorted by hemorrhage. The cupulae of the horizontal and posterior canals were present but that of the superior canal was absent. The cochlea showed hemorrhage in all the scalae. There was a comminuted fracture of the upper coils.



g 6 (left ear of guinea pig 8).—*A*, section through the ampullae of the horizontal and superior canals. ar substance can be seen in position overlying the cristae. Hemorrhage has occurred between the ampul- wall and the bone, with some distortion. *B*, transverse section of the crista in the ampulla of the posterior . The cupular substance is in place. The ampullary wall shows distortion, cause undetermined; possibly istortion is an artefact.

ht Ear: The middle ear showed hemorrhage (3 , with blood free in the cavity and submucosal. vestibule had hemorrhage in the perilymphatic (3 plus). Postmortem degeneration was slight sent. In the utricle the otolithic membrane was nd lying in the ampulla of the horizontal canal,

No postmortem degeneration was noted. (The hemorrhage apparently followed fracture of the tip, with fixation occurring promptly afterward.)

Summary and Correlation of Experimental and Histologic Observations.—Following centrifugation, positional reflexes and reflexes on linear acceleration were absent,

and all otolithic membranes were detached. The spontaneous nystagmus to the right may be due to a lesion of the cupula of the left horizontal canal or to stimulation of the cupula of the right horizontal canal by the thrown-off otolithic membrane. Absence of postrotatory nystagmus to the left and reduction of vasomotor reaction following rotation to the right were observed.

COMMENT

The experiments show that a vasodepressor effect can be produced by labyrinthine stimulation (rotation about a horizontal as well as about a vertical axis) after the otolithic membranes have been thrown off the maculas. This was observed at a stage at which the positional reflexes considered as otolithic in origin could not be elicited; in some instances also the reflexes observed on linear acceleration were abolished,[10] while in most instances postrotatory nystagmus could still be produced and the cupulae were in their normal position. In other words, for the production of an important component of the motion sickness syndrome, such as the vasomotor reaction, the otolithic membranes are dispensable. This does not exclude, of course, the possibility that they may participate in the production of vascular reflexes, at least under certain conditions.

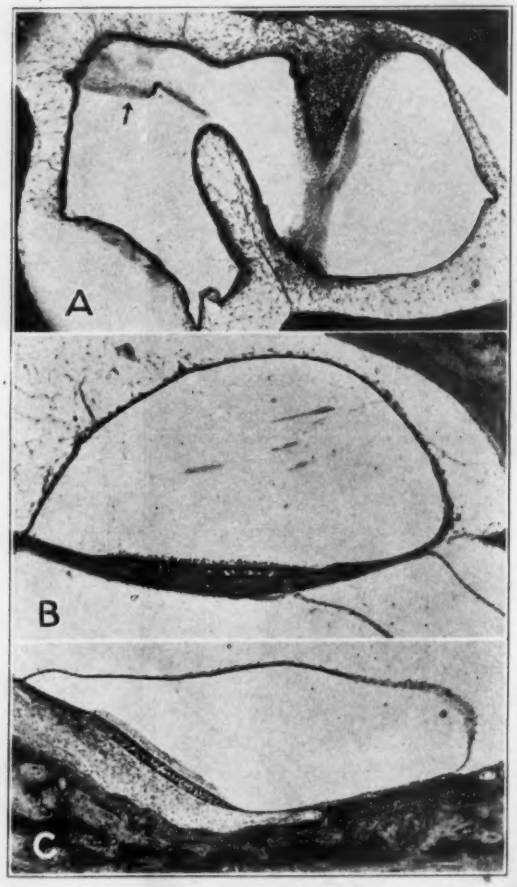


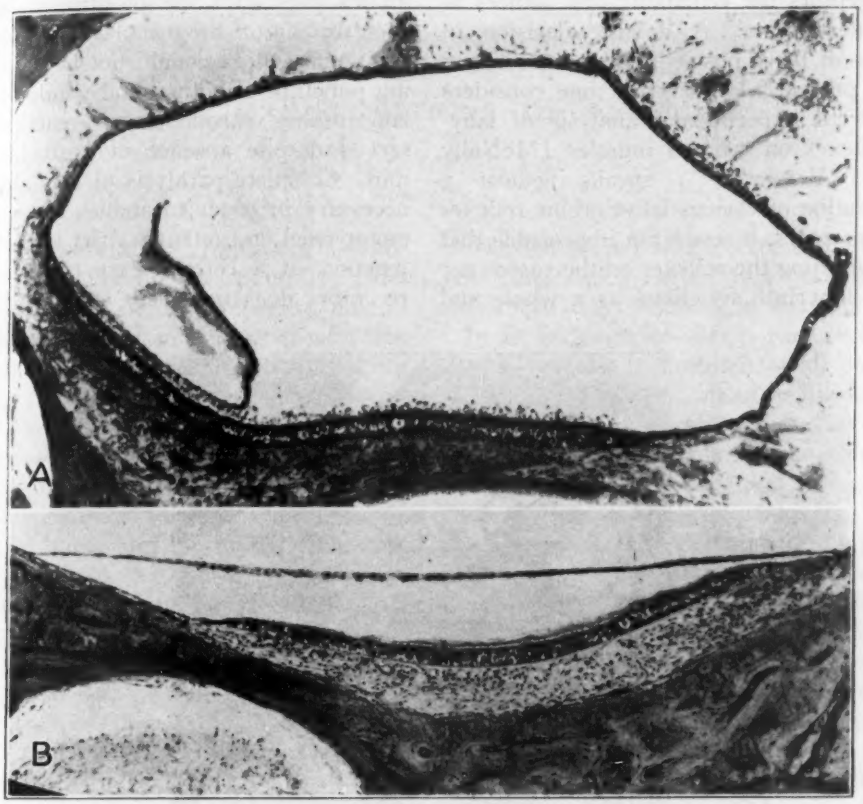
Fig. 7 (right ear of guinea pig 10).—*A*, section passing through the crista and the cupula of the horizontal canal and through the ampulla near the crista of the superior canal. The displaced otolithic membrane from the utricle lies in the latter. *B*, section through the utricle showing the macula from which the otolithic membrane is absent. *C*, section through the saccule. The otolithic membrane is mostly in place over the macula.

Thus we find the vasomotor reaction to labyrinthine stimulation preserved, on the one hand, after the otolithic membranes have been thrown off, and the positional reflexes paralyzed, on the other hand, when postrotatory nystagmus cannot be elicited following bilateral puncture of the round windows. In order to abolish the vestibulovasomotor reaction, it seems necessary to paralyze the labyrinth completely, e. g., by injecting a cocaine solution into the inner ear (Spiegel and Démétriades in rabbits). Similarly it was observed in cats that after a 2 per cent solution of cocaine in 80 per cent alcohol was injected through both round windows the vasomotor reaction was at least transitorily paralyzed (fig. 1*B*).

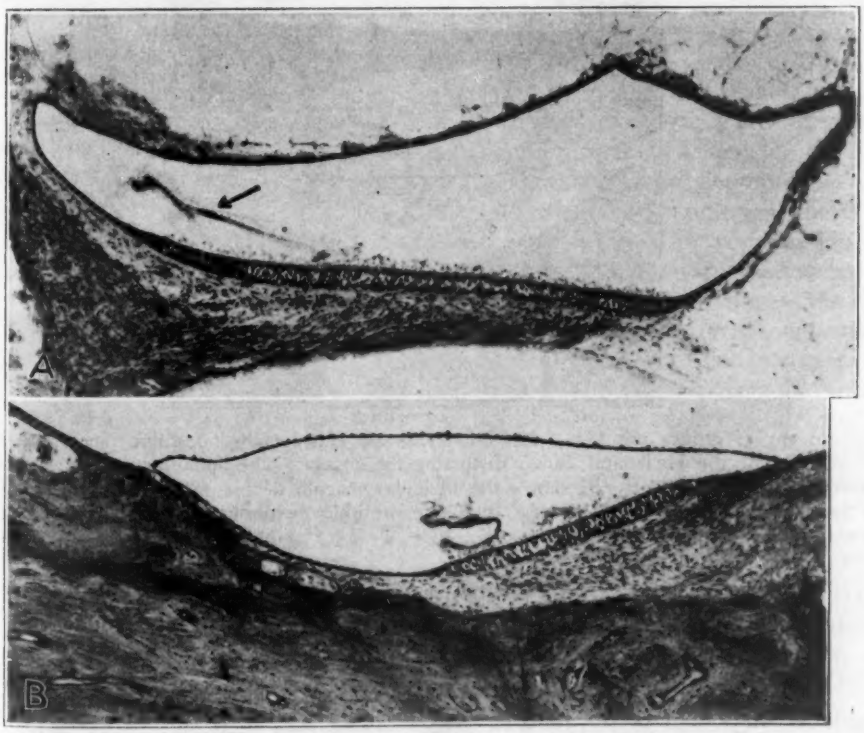
The observations reported in this paper can be interpreted in various ways. It could be assumed that the labyrinthine vasodepressor reaction originates in the semicircular canals only, and that its threshold lies lower than that of the vestibulo-ocular reflex arc, so that rotation is able to elicit the vasomotor but not the ocular reaction when the excitability of the nerve endings in the cristae ampullares is diminished or the endolymph flow on rotation is reduced after puncture of the round windows.

If one takes into account that, according to Maxwell[4] and McNally and Tait,[5] angular acceleration may act as a stimulus not only on the cristae ampullares but on the utricle, the possibility deserves consideration that the otolithic apparatus, as well as the cristae ampullares, may serve as receptor apparatus for the labyrinthine vasomotor reaction, so that on elimination of

10. Regarding the controversial question whether reactions on linear acceleration are otolithic (Breuer: Ueber die Function der Otolithen-Apparate, Arch. ges. Physiol. **48**:195, 1891) or ampullar (Magnus and de Kleijn[7]) reflexes, the present experiments seem to corroborate Breuer's view. We observed in cases of complete detachment of the otolithic membranes loss of the positional reflexes as well as of the reflexes on linear acceleration (see data on guinea pigs 8 and 9). In some instances loss of the positional reflexes was associated with preservation of a part of the reflexes on linear acceleration. In these instances, however, the otolithic membranes were not completely detached (see data on guinea pigs 4 and 10).



g. 8 (left ear of guinea pig 10).—*A*, section through the utricle showing the otolithic membrane mostly ned but adherent to the macula at one border. *B*, section through the saccule showing remnants of the hic membrane still adherent to the macula.



ig. 9 (left ear of guinea pig 11).—*A*, section through the utricle showing the otolithic membrane detached. ection through the saccule showing the otolithic membrane detached except at one border of the macula.

of these receptors the remaining one suffices to produce the reaction. A definite decision in favor of one of these possibilities does not seem possible at present. However, if one considers that the recent experimental analysis of labyrinthine reflexes on striated muscles (McNally and Tait[5]; Versteegh[11]) speaks against a strict localization of various labyrinthine reflexes in certain receptors, it seems not improbable that similarly regarding the reflexes on the vasomotor system the labyrinth functions as a whole and

guinea pigs after the otolithic membranes been thrown off the maculas, at a stage whe positional reflexes could not be elicited. Fo ing puncture of both round windows in cats labyrinthine vasodepressor reaction was served despite absence of postrotatory ny mus. Complete paralysis of the labyrinth s necessary in order to abolish the vestibulo motor reaction, so that a strict localization o reaction in a certain part of the labyrin receptors does not seem warranted.

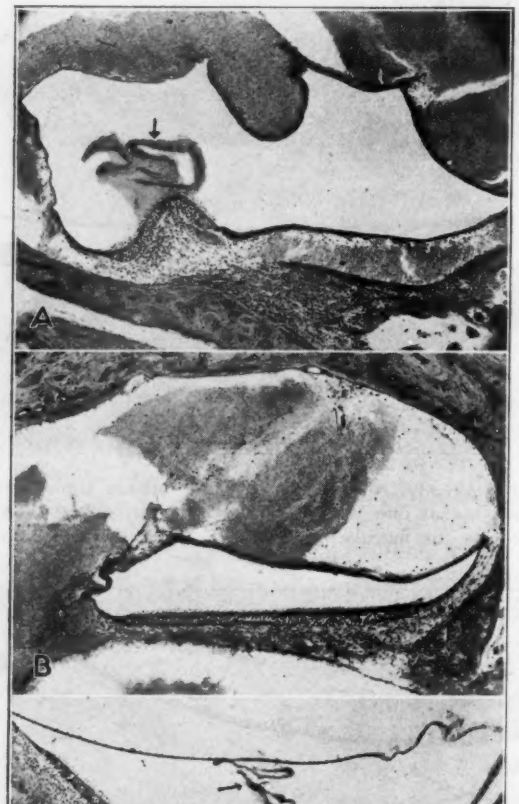


Fig. 10 (right ear of guinea pig 11).—*A*, section showing the detached otolithic membrane from the u lying in the ampulla of the horizontal canal, distorting the cupula. The ampullary walls are distorted by orrhage in the perilymphatic space. *B*, shows the utricular macula devoid of its otolithic membrane. Th much hemorrhage in the perilymphatic space. In *C* the otolithic membrane is seen displaced from the m of the saccule.

that in labyrinthine lesions the various receptors can substitute each other.

SUMMARY

An important component of the motion sickness syndrome, the vasodepressor reaction to labyrinthine stimulation, could be produced in

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11. Versteegh, C.: Ergebnisse partieller Labyr exstirpation bei Kaninchen, Acta oto-laryng. 11:393

AURAL MANIFESTATIONS OF LEUKEMIA

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1856, nine years after Virchow had estab- leukemia as a definite clinical entity, Vidal the significant observation that distur- s of hearing were often associated with this e. While this observation was subsequently med by other investigators, it remained olitzer [1] in 1884 to lay the groundwork for resent knowledge of the pathologic changes cur in the ear in leukemia. He was the first ction the temporal bones in a case of genous leukemia and to correlate the clin- with the pathologic observations. There followed reports of individual cases with psies by Gradenigo,[2] Steinbrugge,[3] Wag- user [4] and others. In 1897 Schwabach [5] ved 15 cases, 10 previously reported by , to which were added 5 of his own. Re- of single cases by the English authors r and Lake,[6] Finlaysin [7] and Mott [8] then red in the literature. In 1906 Alexander [9] hed a comprehensive monograph on the t, in which he reviewed 15 personally ved cases. Within the past twenty-five however, little has been added to the knowledge of aural involvement in leukemia. The publications within this period have been rather sparse, particularly in this country.[10]

In an endeavor to obtain further information on this subject, the records of all patients with leukemia who were admitted to the Mount Sinai Hospital over a period of five years (1929 to 1933) were reviewed, particular attention being given to the otologic condition in each instance. There were 148 cases of leukemia, which was myelogenous in 97 and lymphatic in 51. Abnormalities of the ear were observed in 25 of the cases, or in 16.8 per cent. The impression gained from the review of the records is that this incidence of aural involvement is rather low and that the figures probably would have been considerably higher if a complete otologic examination had been made routinely in each instance. Of passing interest was the observation that ocular changes occurred in 47 cases, or 32.4 per cent, an incidence almost twice that of aural changes. In evaluating these sets of figures it should be borne in mind that examination of the eyes, including the fundi, was a routine procedure, while examination of the ears was not. Of the 25 cases of leukemia with aural changes, 8 were of the lymphatic and 17 of the myeloid type. The age of the patients varied from 5 to 62 years. Twelve patients were male; 13, female.

The aural signs and symptoms were referable to the external, the middle and the internal ear, either separately or in combination. The two chief lesions of the external ear were ulceration and hemorrhage of the membranous and the bony canal wall. The tympanomastoid regions were involved in 12 instances, the predominant lesions here being hemorrhage and inflammatory reaction; the latter varied in intensity from that of mild congestion of the drum membrane to extensive suppuration within the mastoid bone. The internal ear was the site of involvement in

m the Laboratories and the Otologic Service ion of Pathology) of Mount Sinai Hospital.

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10. (*a*) Weiss: Ein Fall von lymphaticher Leukämie, Ztschr. f. Laryng., Rhin. **12**:379, 1924. (*b*) Sternberg, A.: Fall von Myeloblastenleukämie unter dem anatomischen Bild einer lymphatischen Leukämie, Zentralbl. f. Hals-, Nasen- u. Ohrenh. **12**:128, 1928; (*c*) Veränderungen am Gehörorgan und im Rachen in Verbindung mit lymphoider Leukämie, ibid. **17**:317, 1931. (*d*) Jaffé, R. H.: Morphology of the Inflammatory Defense Reactions in Leukemia, Arch. Path. **14**:177 (Aug.) 1932.

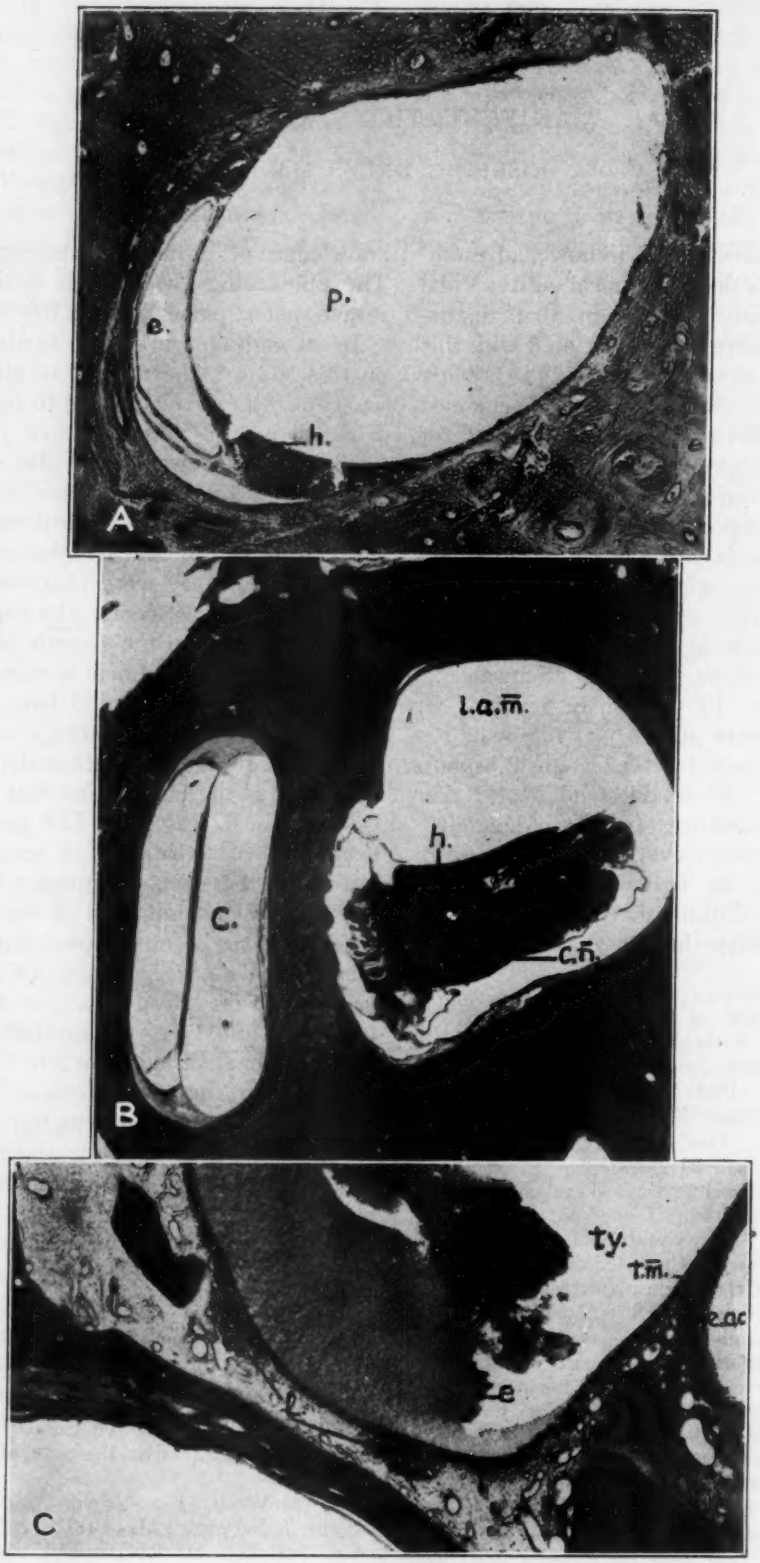

Fig. 1.—*A*, photomicrograph of the horizontal semicircular canal. A hemorrhage of recent origin is p ent in the perilymphatic space. *e.* represents the endolymphatic space; *h.*, hemorrhage; *p.*, the perilymp space. *B*, vertical section through the cochlea showing hemorrhagic exudate about the cochlear nerve i internal auditory meatus. *c.* represents the cochlea; *c. n.*, the cochlear branch of the eighth nerve; *i. a* the internal auditory meatus. *C*, vertical section through the tympanum showing leukemic nodules i submucosa. Serous exudate is present in the tympanic cavity. *e.* represents the exudate; *e. a. c.*, the e nal auditory canal; *l.*, the leukemic nodules; *ty.*, the tympanum; *t. m.*, the tympanic membrane.

es, and this was manifested by hearing im-
nent of the nerve type, nystagmus, vertigo
partial or total loss of vestibular function.
cases the middle and the inner ear were
mitantly involved. In only 1 instance was
paralysis recorded.

the 148 patients whose records were re-
d, 74 died, and of these 45 came to post-
em examination. Unfortunately, only four
oral bones, one from each of 4 patients, were
red for histologic study. They were sec-
d serially. An abstract of the records of
4 patients follows.

REPORT OF CASES

E 1.—A. F., a boy aged 5½ years, was admitted
pediatric service on June 21, 1929, with a history
mplike pains in the abdomen, nausea and fever
g two weeks before admission and followed a
later by pains in the joints and vomiting. These
oms continued unabated until the time of his
ion to the hospital. Examination revealed a child
ill, with cervical, postauricular and axillary
enlarged and tender and with the liver and the
enlarged. Scattered over the entire body were
t hemorrhagic lesions. Ocular examination re-
hemorrhages in the conjunctivas and retinas of
eyes. Both tympanic membranes and middle
were normal. A blood count revealed 384,000
blood cells, of which 1 per cent were polymor-
lear leukocytes, 1 per cent basophils and 98 per
yeloid cells. The child had a septic type of
ature ranging from 99 to 105 F. The palpable
gradually increased in size and number, par-
ly those of the postauricular chain on the right
which eventually had displaced the auricle out-
for a considerable distance. The middle ears re-
d normal throughout the illness. The child's
ion became progressively worse, and he died three
half weeks after admission.

ropsy revealed acute myeloid leukemia with leu-
infiltrations of the spleen, the liver, the kidneys,
ymus, the intestines, the pericardium, the meninges
e lymph nodes. Hemorrhages were present in
in, the pleura, the pericardium, the peritoneum
e conjunctivas.

ologic Examination of the Right Temporal Bone.
morrhages of recent origin were present in the
ian tube, the vestibule, the cochlea—particularly
first whorl—the saccule, the semicircular canals
A), the ductus perilymphaticus, the ductus endo-
aticus and the internal auditory meatus (fig. 1
Nodular infiltrations, comprised chiefly of myelo-
and agranular mononuclear cells, were scattered
hout the thickened mucosa lining the eustachean
he tympanic cavity (fig. 1 *C*) and the pneumatic
of the petrous pyramid. The petrosal marrow
e perineural and epineural sheaths of the eighth
were similarly infiltrated by these cells. Degen-
changes in the organ of Corti and in the end
of the vestibular nerve were observed. The
ic cavity contained serous exudate but no frank

hough clinically the child in case 1 did
resent signs or symptoms referable to the
either of a leukemic or of an infectious
nature, throughout the entire illness, subsequent histologic examination of the temporal bone disclosed hemorrhages and leukemic infiltrations widely dispersed within the right middle and inner ear and in the petrosa. These pathologic changes can probably best be explained on the basis that they were local manifestations of leukemic lesions distributed throughout the body. It is of interest to note that in some of the cases reported the leukemic manifestations were confined chiefly or solely to the ears, while in others, although the leukemia was ushered in only by otologic symptoms, these were followed by symptoms referable to other parts of the body.

CASE 2.—L. M., a boy aged 5 years, was admitted to the pediatric service, Oct. 28, 1932, with a one month history of swelling of the cervical, axillary and inguinal glands and of enlargement of the abdomen. The palpable cervical glands gradually increased in size and number, and ultimately formed a complete chain extending from ear to ear below the mandible. Examination revealed an acutely ill child with a temperature of 101 F. Purplish spots were diffusely scattered over the entire body. There was enlargement of the cervical, axillary and inguinal nodes, and small hemorrhages were seen on the tonsils and on the posterior pharyngeal wall. The liver and the spleen were also enlarged. Both tympanic membranes and middle ears were normal. The white blood cell count was 105,200, with undifferentiated cells (blast cells) 83.5 per cent, polymorphonuclear leukocytes 8 per cent, lymphocytes 7 per cent and mononuclear leukocytes 1.5 per cent. Since some of the undifferentiated cells showed a tendency toward polymorphism, and since they took up the oxidase stain, the diagnosis of myeloid leukemia was considered most plausible.

The boy had repeated attacks of epistaxis, which were controlled with great difficulty. Roentgen therapy to the glands, the liver and the spleen afforded only slight relief of symptoms. The course became steadily worse, and death occurred five days after admission.

Necropsy showed (1) acute myeloid leukemia with infiltration in the lungs, the heart, the thymus, the liver, the spleen and other organs, (2) generalized leukemic lymphadenopathy and (3) petechial hemorrhages in the lungs, the epicardium and the kidneys.

Histologic Examination of the Right Temporal Bone.—Hemorrhages and leukocytic infiltrations were diffusely dispersed throughout the external, the middle and the internal ear as well as in the pars petrosa. These infiltrations were observed in the subepidermal tissue lining the external auditory canal, in the submucosa lining the tympanic cavity (fig. 2 *A*), in the stapedius muscle and in the chorda tympani, also in the scalae of the cochlea, in the stria vascularis, in Reissner's membrane and in the macula sacculae of the internal ear. The facial and auditory nerves including the geniculate and Scarpa's ganglion were similarly affected. The tympanum and the mastoid cells showed evidence of an acute suppurative process with extensive resorption of the bony intercellular septums. Atrophic changes were noted in the end organs of the cochlear and vestibular divisions of the eighth nerve. A moderate amount of free pigment was present in the modiolus.

This case, like the first, is one of acute myeloid leukemia with general dissemination of the

lesions. Here again there was no reason to suspect involvement of the ears during the entire illness, yet subsequent histologic examination of the right temporal bone revealed the presence of leukemic infiltrations in the external, middle and inner ears, together with a suppurative process in the tympanum and the mastoid process.

observed. The blood count revealed 750,000 white cells, of which 98 per cent were lymphocytes; the nosis of lymphatic leukemia was therefore entert Both middle ears were normal. The cutaneous er responded favorably to radiotherapy, and the patien discharged somewhat improved two weeks after a sion. Treatment was to be continued in the outp department.

Thirteen months later the patient was readm Six months prior to this admission, purulent

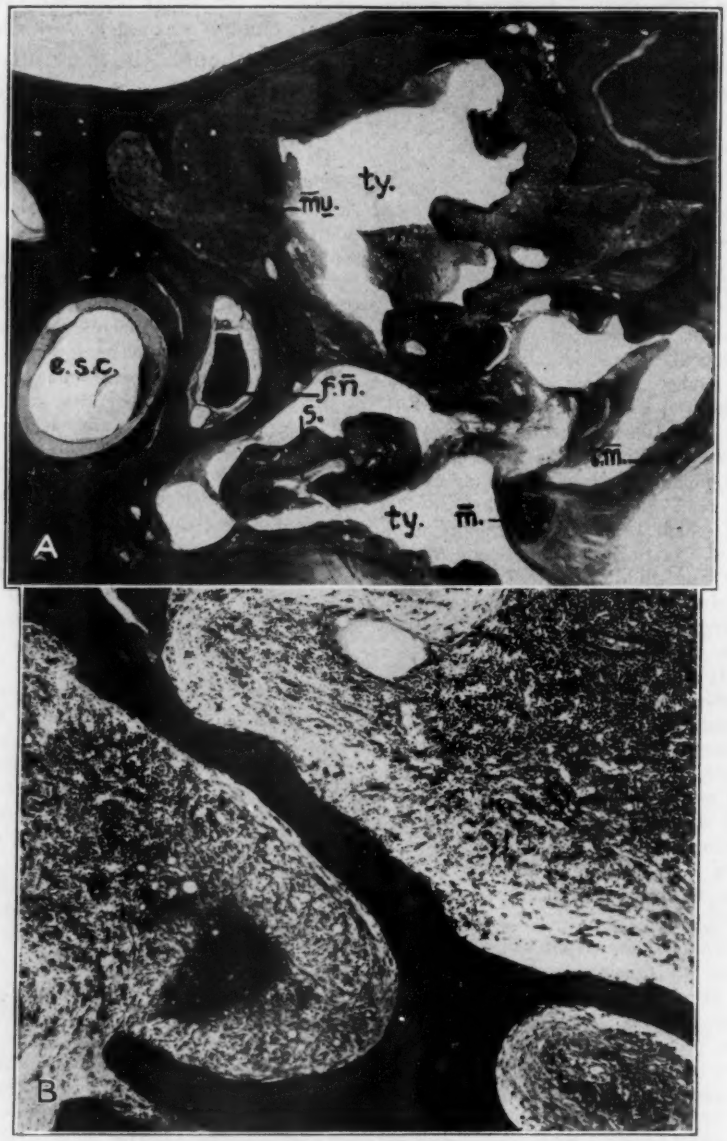

Fig. 2.—*A*, vertical section through the tympanum showing pronounced thickening and diffuse cel infiltration of the submucosa. Purulent exudate is present within the tympanic cavity. *e. s. c.* repre the external semicircular canal; *f. n.*, the facial nerve; *m.*, the malleus (short process); *s.*, the stapes; the mucosa; *ty.*, the tympanum; *t. m.*, the tympanic membrane. *B*, section through petrous pyramid s ing leukemic infiltrates in the marrow. Note the diffuse cellular infiltration in the marrow spaces.

Case 3.—A. K., a man aged 49, was admitted to the medical service on Nov. 20, 1928, with an eight week history of swelling of the cervical, axillary and inguinal glands. On examination, besides the glandular swelling, splenomegaly and lesions of the skin over the arms, interpreted as leukemoids by the dermatologist, were

media associated with swelling and redness of auricle developed on the left side, which was follo shortly thereafter by total deafness. The swelling the redness of the auricle gradually subsided, but discharge persisted. Examination again revealed erous lesions of the skin (leukemoids), enlarged cerv

ry and inguinal glands and an enlarged liver. A count showed 27,000 white blood cells (having ed from 750,000 on the previous admission), 83 ent of which were lymphocytes and 17 per cent orphonuclear leukocytes. Otologic investigation ed a large central perforation with scant otorrhea left side; the mucosa lining the inner tympanic was markedly swollen. Tuning fork tests showed l loss of hearing. The otologic picture was that ronic suppuration of the middle ear with labyrinthine involvement. The right drum membrane was found to be retracted but intact, and the hearing was relatively normal. About a month later the right ear began to discharge foul-smelling pus from an anterior perforation. The remainder of the drum was unchanged, and the hearing was slightly affected.

During his stay in the hospital the patient experienced a series of acute infections—oropharyngitis, an abscess of the upper lip and one behind the right ear. Finally an obstructive type of jaundice and bronchopneumonia

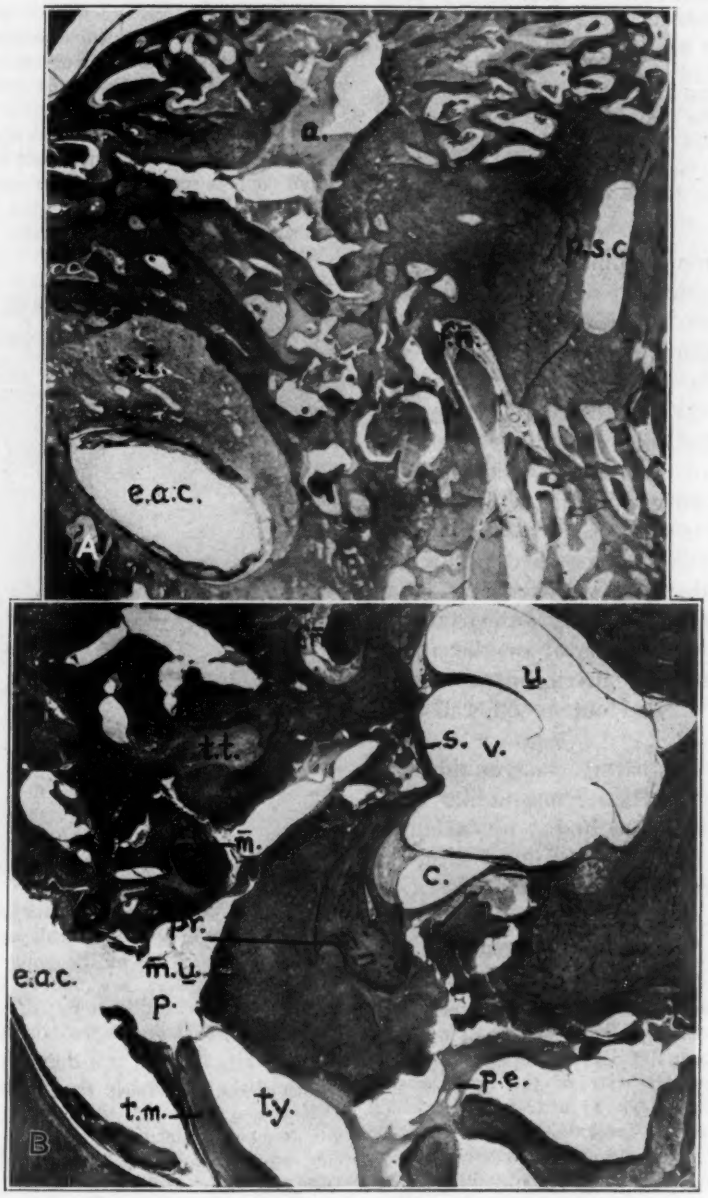

Fig. 3.—*A*, vertical section through the mastoid antrum. The pronounced thickening of the subepidermal e of the external auditory canal can be seen. Purulent exudate is present within the antrum and the ntral cells. *a.* represents the antrum; *e. a. c.*, the external auditory canal; *s. t.*, the subepidermal tissue; *c.*, the posterior semicircular canal; *f. n.*, the facial nerve. *B*, vertical section through the tympanum ing the markedly thickened mucosa lining the inner tympanic wall. The mucosa is diffusely infiltrated cellular elements. Purulent exudate is present within the tympanic cavity. *c.* represents the cochlea; *c.*, the external auditory canal; *f. n.*, the facial nerve; *m.*, the malleus; *mu.*, the mucosa; *p.* a perfora- of the drum membrane; *p. e.*, purulent exudate; *pr.*, the promontory; *s.*, the stapes; *ty.*, the tympanum; , the tympanic membrane; *t. t.*, the tensor tympani (tendon); *u.*, the utricle; *v.*, the vestibule.

developed, and about ten weeks after admission the patient died.

Necropsy disclosed chronic lymphatic leukemia with leukemic infiltrations of the lymph nodes, the liver, the spleen, the lungs, the heart and the kidneys.

Histologic Examination of the Right Temporal Bone.—A considerable amount of hemorrhagic and purulent exudate was present in the tympanum, particularly about the oval and the round window, in the antrum and in the eustachian tube. The mucosa lining these cavities was thickened and infiltrated by inflammatory cells, and the overlying epithelium was ulcerated in some areas. A large abscess was seen in the peritubal region. Hemorrhagic exudate was present in the labyrinth, particularly in the saccule. Leukemic infiltrations were scattered throughout the marrow of the temporal bone (fig. 2 *B*). There was degeneration of the cochlear and vestibular nerve fibers in the internal auditory meatus and to a lesser degree of the ganglion cells in Scarpa's ganglion.

In case 3 the chronic lymphatic leukemia was complicated by suppuration of both middle ears with total loss of hearing on the left side. Since only the right temporal bone was procured for histologic study, the nature of the pathologic changes in the left ear and the cause of the total loss of hearing on that side can only be surmised. The sudden onset of deafness, however, speaks in favor of a diagnosis of hemorrhage involving the labyrinth. This is supported by the histologic observation of hemorrhage localized to the opposite (right) labyrinth. Nevertheless, an infection extending to the labyrinth from the middle ear by way of the oval or the round window, with suppurative labyrinthitis resulting, cannot be definitely ruled out as the causative factor.

The extensive inflammatory changes throughout the right temporal bone, not unlike those seen in other parts of the body—for example, in the oropharynx and on the upper lip—can probably best be explained on the basis of an apparent lack of ability on the part of the patient's tissues to localize an infection.

CASE 4.—E. M., a girl aged 5, was admitted to the pediatric service on Sept. 22, 1932, with a sixteen week history of epistaxis, purpuric spots on the skin and a temperature ranging from 100.5 to 104 F. Two months prior to admission the left side of the neck became swollen. This was attribtued to a bad tooth, which was extracted but without favorable influence on the swelling. She was treated at another hospital, where transfusions and roentgen therapy were administered, but again without apparent improvement. A swelling appeared on the right side of the face, similar to that on the left. Examination revealed a child acutely ill, with cervical, axillary and inguinal glands enlarged and with the spleen and the liver enlarged. The gums were swollen and edematous. Both tympanic membranes were normal. A blood count showed 13,000 white blood cells, of which 75 per cent were lymphoblasts. Four days after admission there appeared a thin serosanguinous discharge from the left ear with tenderness over the mastoid. A smear made from the discharge of the middle ear showed 88 per cent ly cytes and 12 per cent polymorphonuclear leuk Streptococcus haemolyticus was cultured. Tw later postauricular swelling appeared. This, t with increasing tenderness in the region of the m process and impaired hearing, was strongly sugg of acute mastoiditis, although the possibility of a flamed postauricular gland accounting for part picture had to be borne in mind. Roentgen exa tion disclosed diffuse haziness over the entire m process with possible coalescence of the cells at t Because of the hopeless condition of the patient, s intervention was deemed inadvisable, and ro therapy was substituted. Subsequently, severe er otitis developed on the affected side, with ulcerati the skin lining the canal.

During the illness the temperature remained s in character, the glands increased in size, and the h globin content receded to 14 per cent. About two w before death the right ear also began to disch From then on the patient's course went steadily d

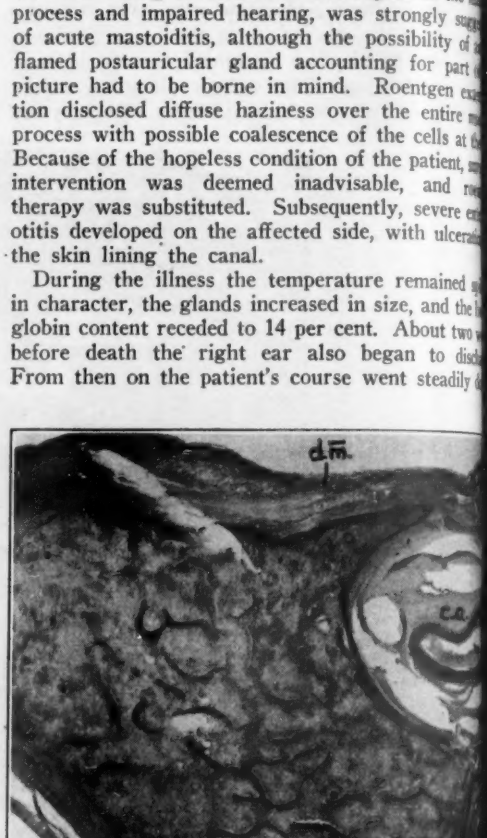

Fig. 4.—Vertical section through the apex of petrous pyramid showing small leukemic infiltration the marrow. Some of the bony trabeculae separa the marrow spaces are undergoing resorption. represents the carotid artery; *d. m.*, dura of the m fossa; *d. p.*, dura of the posterior fossa.

hill, and she succumbed four months after admissi

Necropsy revealed subacute lymphoblastic leuk involving the spleen, the bone marrow, the lymph n and other organs and leukemic infiltrations of the neys, the heart and the liver.

The right temporal bone was not obtained for h logic sectioning. However, on opening the mas process for inspection, gangrenous necrosis of the b intercellular septums was revealed. The adjacent ly glands were also found to be necrotic.

Histologic Examination of the Left Temporal B —The integument lining the external canal was siderably thickened and diffusely infiltrated by infl matory cells, chiefly of the lymphocytic variety 3 *A*). A suppurative process was present in the t panum and the eustachian tube; the mucosa lining t

s was unusually thickened and diffusely infil- by red blood cells, lymphocytes, plasma cells and orphonuclear leukocytes, these cells often assuming rm of discrete nodules (fig. 3 *B*). The ossicles embedded in this hyperplastic inflamed mucosa ere in the process of undergoing bony resorption. ympanic membrane showed a large perforation margins completely lined by epidermis. The mas- one was the seat of an extensive suppurative s, being almost entirely replaced by one large s cavity. The marrow throughout the temporal was diffusely infiltrated by leukemic nodules, but filtration was particularly noticeable in the petro- ex where, as a result of it, the bony trabeculae ndergone extensive resorption. The facial and ic nerves were also infiltrated by cellular elements. labyrinth showed no abnormalities with the ex- n of mild degenerative changes in the sensory endings.

this case as in case 3 the leukemia was plicated by a suppurative process in both le ears. The rapidity with which the infec- spread to the right mastoid bone is striking. four days after the onset of the otitis frank of acute mastoiditis were already manifest ally, and ten days later extensive gangre- necrosis of the intercellular septums in the oid bone was encountered on necropsy. fulminating infection in the mastoid bone, ell as the severe infection in the left external can best be attributed, as previously men- d, to an impairment of the immunity of the es in leukemia.

further interest in this case is the excep- lly high lymphocyte count on a smear of the arge from the middle ear instead of the l preponderance of leukocytes, as would be cted. In this connection, Jaffé [10d] made the esting observation that patients with leuke- react to an infection in a manner simi- o that of normal persons provided there is ent in the former sufficient myeloid tissue ble of producing adequate granulocytes. The ounced lymphocytic reaction in this case t therefore be explained either on the basis the exudate from the middle ear was essen- y hemorrhagic in nature and consequently ved a cell count with a differential count lar to that obtained from the blood itself, or on basis that the myeloid tissue was exhausted thus was incapable of supplying polymor- uclear leukocytes. As a result, the hyper- tic lymphatic marrow substituted lymphocytes leukocytes.

COMMENT

The lesions within the ear observed clinically on histologic examination usually constitute l manifestations of a generalized leukemic sion of the body. Except for slight vari- ns due to the peculiar anatomy of the ear, are similar in character to the lesions seen elsewhere in the body and are comprised chiefly of hemorrhage and cellular infiltration. Any or all the component parts of the ear may be affected in the course of the leukemia. Of particular interest are the lesions which occur in the middle and inner ears. A hemorrhage in the middle ear, for example, is not infrequently subjected to secondary infection and as a result may present a picture not unlike that seen in the usual infections of the middle ear. On the other hand, a suppurative process in the middle ear may occur as a complication of the leukemia in the absence of a preexisting hemorrhage at this site and may simulate the otitic infections seen complicating other debilitating diseases.

Of the 25 patients with aural involvement in this series of 148, the middle ear was affected in 12 and the internal ear in 9. Alexander's [9] figures show a much higher incidence, the middle ear being involved in 9 of 16 patients and the internal ear in 11. This variation in incidence may be due to the fact that our figures are based both on clinical and on histologic observations, whereas Alexander's figures are based solely on histologic studies.

In addition to hemorrhage, cellular infiltration and inflammatory reaction, already referred to, compression and ectasia of the membranous parts, acute exudative processes, degeneration of the sensory nerve endings and abnormal pigmentation comprise the pathologic changes in the labyrinth observed on histologic examination.

It is noteworthy that pathologic alterations in the middle and inner ear may be observed histologically in cases in which previously no physical signs or symptoms were present. Thus in 2 of the cases herein reported (3 and 4) extensive suppuration of the middle ear, and in a third (1) diffuse hemorrhage into the labyrinth, were observed on histologic examination although there was no clinical evidence or even a basis for suspicion that either of these conditions had ever been present during the illness. Not infrequently the reverse picture is seen; namely, there is clinical evidence of labyrinthine involvement—hemorrhage being strongly suspected—yet subsequent histologic examination of the temporal bone fails to disclose any pathologic alterations within the labyrinth or in the adjacent vestibular nerve to account for the condition. Similarly, in 2 of the 15 cases reviewed by Schwabach [5] a diagnosis of labyrinthine disease made clinically could not subsequently be corroborated on histologic examination. Krepuska, in a discussion of Sternberg's [10b] paper, expressed the opinion that labyrinthine symptoms may be provoked by repeated insults of small hemorrhages in the labyrinth, the ultimate effect on this structure

being the same as that produced by one large sudden hemorrhage.

The impression gained from a study of the present series is that inflammatory lesions occurring in the ear are comparatively more severe in the leukemic than in the nonleukemic patient.

SUMMARY AND CONCLUSION

An analytic review of the medical records of 148 subjects with leukemia admitted to the Mount Sinai Hospital over a period of five years, with particular attention to aural involvement and a more detailed study of 4 of the patients who died and from each of whom a temporal bone was procured for histologic examination, with a brief review of the literature, yielded the following conclusions:

1. Aural complications of leukemia are more prevalent than is generally believed. They occurred in 25 of the 148 cases reviewed, or in 16.8 per cent. Routine examination of the ears including functional tests of the cochlear and vestibular nerves would undoubtedly disclose an even greater incidence.

2. The aural complications include disease the external, the middle and the internal ear of their adnexa.

3. The pathologic changes in the ear, as where in the body, are comprised chiefly hemorrhage, cellular (leukemic) infiltration inflammation.

4. Pathologic changes in the ear may be vealed on histologic examination even in cas which there was at no time during the illness clinical evidence of aural disease.

5. Otitic infections are comparatively severe in the leukemic than in the nonleuke patient; they not infrequently show a st tendency toward early invasion of the adja structures.

6. The diagnosis of acute mastoiditis in a kemic subject may paradoxically be made difficult by the presence of postauricular swel and sagging of the bony external canal wall, these signs, so well recognized as pathognom of suppuration in the mastoid bone, may su such circumstances also represent leukemic in trations in the adjacent soft parts.

ABSCESS OF THE NASAL SEPTUM COMPLICATING ACUTE ETHMOIDITIS

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bscess of the nasal septum caused by trauma t uncommon. The purpose of this paper is ll attention to the rarer abscess of the sep- caused by suppurative inflammation extend- rom the lateral cellular mass of the ethmoid . The pathway of extension may be ex- ed on an anatomic basis. Skillern [1] has aptly d that "the right and left capsules hang down ach side of the nasal septum similar to bags, lower corner projecting downward like a der process." To supplement this it may be d that the outer part of the top of each bag pen. In the articulated skull this open part osed in by the frontal bone and the lesser of the sphenoid bone. The ethmoid bone is bone, consisting of a vertical plate and two al cellular masses. Thus the frontal and noid bones form part of the roof of each al ethmoid cell mass. This arrangement rds a direct pathway of extension from the tal and from the sphenoid sinus into the eth- l sinus.

may be assumed that infection proceeds from lateral mass along the roof and across the riform plate to the septum. The infection also involve the meninges and other intra- ial structures, such as the venous sinuses. act, such complications have been reported. s type of septal abscess is to be regarded as ndary; that following trauma is primary. t infection from primary traumatic abscess e septum may extend to one or both lateral ses is also a logical assumption. That menin- is a possibility is unquestionable, and the rmination of this might well be made the f objective in a large series of cases.

n one of the cases reported herewith an ex- nation of the spinal fluid was not made, as the ent responded promptly to drainage and gave clinical evidence of meningeal involvement. the other case there was evidence of mild ction of the meninges.

Infection extending from the ethmoid capsules into the septum or vice versa probably is due to continuity of tissues. Infection has been shown to travel from the septum to the meninges by way of the perineural olfactory nerve sheaths and the lymphatic channels connected with them. Infection extending from the lateral ethmoid mass may take the same pathway to the meninges. Infection extending from the nose to the longitudinal and cavernous sinuses is probably endovascular or perivascular. Infection of the bones of the skull occurs by phlebitis or by continuity of tissues.

Continuity of tissues is probably the chief pathway of infection extending from the lateral ethmoid mass to the septum. By this route the organisms must travel across the cellular roof and cribriform plate and in so doing are in close proximity to the meninges. From the overturned kerosene lamp to the burning of a large part of a city is sometimes only a matter of a few minutes of time. Involvement of the cellular roof and cribriform plate may be regarded as such a hazard.

Recognition of the septal abscess is important because it marks the end of a road which affords a readily accessible place for drainage, in addition to intranasal or extranasal drainage of the ethmoid sinus at the source of infection. Such drainage should be prompt and early. The possibility that osteomyelitis may follow operations done early should not influence the decision for early drainage of the ethmoid cells. Prevention of meningitis should receive prior consideration. Osteomyelitis may occur when no surgical treatment has been applied to the sinuses.

Runge [2] stated in 1928 that infection of the septum may follow infection of the ethmoid sinuses and mentioned that Antre traced a septal abscess to a carious ethmoid bone. Rudakoff [3] in

Read at the meeting of the New England Otolaryngology Society, Boston, Nov. 15, 1944.

1. Skillern, R. H.: The Catarrhal and Suppurative Diseases of the Accessory Sinuses of the Nose, Philadelphia, J. B. Lippincott Company, 1913.

2. Runge, H. G.: Entzündliche Erkrankungen der Nasenscheidenwand, in Henke, F., and Lubarsch, O.: Handbuch der speziellen pathologischen Anatomie und Histologie, Berlin, Julius Springer, 1928, vol. 3, pt. 1, pp. 127-130.

3. Rudakoff, W. O.: Zur Kasuistik der Nasenscheidenwandabszesse nach Grippe, Monatschr. f. Ohrenh. **62**:1319-1334, 1928.

1928 reported that abscess of the nasal septum was the rarest of the nasal complications of grip, occurring in only 3 per cent of cases. It can therefore be stated that it is not common even in epidemics. Voorhees'[4] statement that "abscess of the nasal septum is one of the commonest of intranasal conditions" is not substantiated by other sources nor by my experience. His statement that "the common causes of septum abscess are trauma, infected hematoma and submucous resection of the septum" is undoubtedly true. In 1930 Benjamins[5] reported 3 cases of osteomyelitis of the cranial bones in association with an inflammatory lesion of the nasal septum, in none of which in his opinion was there evidence of sinus involvement. One of the 3 patients died. In 1932 Hofmann[6] reported a case of abscess of the nasal septum with consecutive meningitis and rupture of a cerebral artery, which resulted fatally. He stated that the autopsy showed involvement of the left ethmoid cells but that this was so slight that it could not have been responsible for the meningitis. Yet in another place in the report he mentioned that the left posterior ethmoid cells were filled with a mucopurulent substance. His most important observation was that the inflammation progressed directly from the septal mucosa along the olfactory nerve and that the perineural lymph spaces contributed to its spread. He came to no definite conclusion as to the cause of the septal abscess. The infecting organism was a streptococcus. In 1933 Baldenweck, Roueche and Levy-Deker[7] reported a case of nasal suppuration and lymphatic meningitis. There was an attack of tracheopulmonary grip with signs of bronchitis and slight rhinopharyngeal infection. At the same time there was swelling of the left nostril and cheek up to the forehead. There was a history of a fall, the child striking on forehead and cheek. The left nostril showed a bulging swelling. This was incised endonasally and a large abscess drained. A roentgenogram showed blurring and diminished transparency of ethmoid cells and of the left frontal sinus, indicating ethmofrontal sinusitis on the left side. The patient was slightly rigid, and Kernig's sign was present to a slight degree. The child recovered. In a fatal case of absc the frontal lobe following abscess of the septum, reported by Berendes,[8] ethmoiditis demonstrated at operation, but the author that such involvement is no ground for a ing that the infection had progressed int cranial cavity. There was no history of tr the primary condition having been infla tion and swelling of the nasal vestibule d infection. Marsh[9] stated that:

> Abscess of the nasal septum is far from being quent occurrence; in fact, in a large clinic one not see more than three or four cases in a year.
>
> Statistics for Edinburgh Infirmary tabulated by Maxwell for the twenty years 1907-26, record sixt cases of abscess of the septum out of a total of cases of intranasal disease.

In 1935 Combecher[10] reported that record the Marburg Otorhinolaryngological Clinic 1926 to 1934 show 23 cases of abscess of the tum. In 1 of these cases the abscess follo submucous resection for frontal headache, irritation and obstruction. The patient also chronic serous ethmoiditis with endonasal formation. The author commented on scarcity of fatal complications. Robbio Ca and Galante[11] reported 2 cases of spontan abscess of the nasal septum. In one, the ported roentgenographic evidence of right m lary sinusitis with no evidence of abnormali the frontal sinuses. The condition of the eth sinuses was not mentioned. In the other there was no mention of involvement or of i tigation of the sinuses. In 1939 Kecht[12] the following causes of septal abscess:

1. Nasal trauma.
2. Endonasal operation.
3. Inflammatory conditions of the nose and its parts (furuncles, erysipelas, suppuration accessory cavities).
4. Abscesses of dental origin.
5. General infections, such as grip, typhus, variola, scarlet fever, measles.
6. The so-called idiopathic abscess, a classificati accepted by some authors. Passow believe have a definite origin, such as colds, disea the accessory cavities, eczema, etc.

4. Voorhees, I. W.: Management of Abscess of the Nasal Septum, Laryngoscope **39**:652-654 (Oct.) 1929.

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922 Clay [13] reported a case of abscess of nasal septum followed by infection of the and the cavernous sinus. The septal ab- followed trauma. The pathway of the in- n to the cavernous sinus was regarded to been by way of the ethmoidal and ophthal- veins. In 1928 Rosenberger [14] reported 3 of abscess of the nasal septum, in 2 of which owed trauma; in the third it was designated iopathic. For the purpose of this paper only so-called idiopathic case is of interest. Ap- ntly he made no investigation as to the con- n of the sinuses, but he suggested that the tion in such cases may possibly find entrance e location of the rudimentary vomeronasal n, a suggestion which is at best highly con- ral.

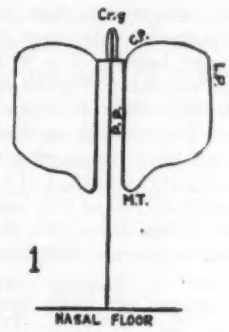
hen a dental abscess precedes the septal ab- , the dental abscess is practically always in pper incisor region. In American literature traumatic source alone has been stressed; more has been written on nontraumatic ns in the foreign literature.

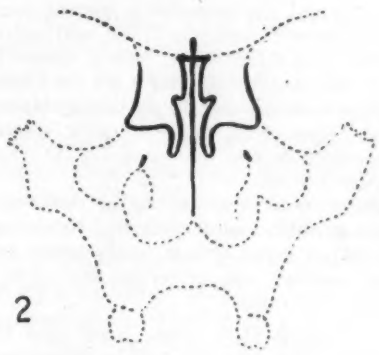
wo patients with abscess of the nasal sep- following acute sinusitis were seen and ed by me during the past three years.

REPORT OF CASES

SE 1.—Nancy P., a white girl aged 10, was admitted hospital on Aug. 20, 1943. Her past history is want.

evious to her illness the patient had been swim- daily. Two weeks prior to admission she e afflicted with a head cold, which seemed to e, but four days later she had a high fever and a che and was given acetylsalicylic acid and put to The following day she was apparently better and llowed to be out of bed. Two days before admis- to the hospital she went to a Girl Scout party she was made uncomfortable by the smoke from mpfire. That evening she again had a fever and seen by the family physician, who prescribed a amide compound and rest in bed. The temperature down promptly. At this time the nasal mucosa markedly edematous and swollen, causing total ge of nasal breathing. She complained of intense che and pain in the nasal and orbital regions. At ime she was first seen by me, and the aforemen- signs and symptoms were observed. The edema- swelling of the nasal mucosa completely shut off e intranasal space on both sides. The external was sensitive to pressure along its whole length, he bridge was swollen and widened but not red. nasal septum was greatly thickened and boggy, septal abscess was suspected. The pharynx was emic. The ears were normal. She was admitted hospital, and roentgenograms of the sinuses were ed. These disclosed involvement of the anterior and posterior ethmoid cells on both sides. The frontal and maxillary sinuses revealed nothing abnormal. The sphenoids showed slight veiling.





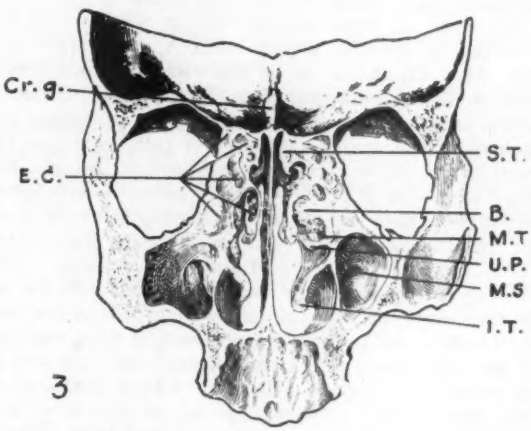


Fig. 1.—Diagrammatic representation of the ethmoid capsule: *Cr.g.*, crista galli; *C.P.*, cribriform plate; *P.P.*, perpendicular plate; *L.P.*, lamina papyracea; *M.T.*, middle turbinate. (After Skillern.[1])

Fig. 2.—Relation of the ethmoid capsule to the surrounding structures. Where the solid line is missing at the top, the frontal bone anteriorly, and the sphenoid bone posteriorly, fill in the gap. (After Skillern.[1])

Fig. 3.—Cross section behind uncinate process showing relation of the ethmoid capsule to the surrounding parts: *Cr.g.*, crista galli; *E.C.*, ethmoid cells; *S.T.*, superior turbinate; *B*, bulla; *M.T.*, middle turbinate; *U.P.*, uncinate process; *M.S.*, maxillary sinus; *I.T.*, inferior turbinate. (After Skillern.[1])

Clay, J. V. F.: Abscess of Nasal Septum Fol- by Orbital and Cavernous Sinus Infection, J. & Laryng. **26**:254-256, 1922.

Rosenberger, H. C.: Abscess of Nasal Septum, State M. J. **25**:463-465, 1929.

The diagnosis was bilateral acute suppurative ethmoiditis and abscess of the nasal septum.

On August 21, the next day, the patient was taken to the operating room and placed under anesthesia. With the aid of a long slender speculum, the ethmoid cells on both sides were opened with curet and forceps under the middle turbinate bones. The working space was small and cramped because of the marked mucosal swelling. Epinephrine hydrochloride applied locally had no shrinkage effect. The mucosa on the left side of the septum was incised over the cartilaginous area and a large abscess evacuated. A pledget of folded petrolatum-impregnated gauze was tucked into each ethmoid area, and a soft rubber tubing drain, into the septal incision. There was no visible necrotic cartilage or bone in the septum.

The patient recovered gradually and was discharged on the seventh day after operation. During her stay in the hospital she received sulfathiazole medication. Culture of material from the abscess showed Staphylococcus aureus. On the day of operation, the red blood cell count was 4,810,000, and the hemoglobin content was 90 per cent. The white cell count was 27,300, with polymorphonuclear leukocytes 82 per cent, young forms (nonsegmented) 25 per cent, eosinophils 0 per cent, basophils 0 per cent, large mononuclears 10 per cent and lymphocytes 3 per cent. This count indicated fairly severe sepsis. The temperature at the time was 102 F. Urinalysis gave negative results.

The patient was seen at regular intervals for a month, during which time the sinusitis slowly and gradually cleared up under Proetz displacement treatment. The septal cartilage was preserved, and there was no saddle bridge deformity.

CASE 2.—Edward M., a white youth aged 17, is one of male twins. When 4 years old he underwent adenotonsillectomy. He had measles, pneumonia and cervical adenitis during childhood. There had been occasional headache but no definite history of sinusitis.

On April 21, 1941, two days before admission to the hospital, he attended school and felt well. The next day, April 22, at 2 a. m. he was awakened by a toothache in the right upper jaw. He applied "toothache drops" and heat and went back to bed. Roentgen examination later gave no evidence of pathologic involvement of the dental roots or of the alveolar process, but there were several cavities in the crowns. In the morning he felt better and ate his breakfast. At 11: 30 a. m. he felt drowsy and had pain in the right side of the face. He again applied heat and went to sleep. That evening he had his supper and went to bed. At 3 a. m. he was awakened with pain of the right side of the face. At 11: 30 a. m. he noticed, for the first time, swelling of the right cheek. Breathing through the right side of the nose was blocked, and there was a discharge in the right nostril. About 1 p. m. he was first seen by the family physician, who prescribed inhalations of steam and acetylsalicylic acid. At 6 p. m., the swelling had involved the right lower eyelid, and there was epiphora. At this time the mother did not notice any fixation of the eyeball. That evening, April 23, he was admitted to the hospital, at which time he was somewhat incoherent, stuporous and disoriented as to time and sequence of events. The findings after admission were as follows:

On the right side of the face the skin was stretched, shiny and red, with swelling of the underlying tissues. The swelling extended from the upper eyelid to the mandible, medially to the nose and posteriorly not as far as the parotid region. There was tenderness below the right eye just lateral to the nose. There was edema but no sign of abscess pointing or fluctuation. Th of the nose was pulled toward the right side, and was a seropurulent discharge in the right nostril co from high in the chamber. The left eye was no and sight was normal. The right eyeball protr the lids were swollen, red and edematous; the junctiva was injected and chemotic at the angles pupil was dilated but reacted slightly to light; ments of the eyeball were greatly limited, the eye almost fixed. The disk was almost obliterated (cho Sight was reduced to perception of form and The tongue was dry; the mucous membrane, normal inner side of the right cheek was swollen and p downward. The ears were normal. The right maxillary lymph nodes were enlarged but not tend painful, or adherent to the skin or the deeper struct The neck muscles were flaccid, and there were no pable glands low down; the trachea was in the mi The chest was clear. The cardiovascular system normal; the quality of the heart action, fair. abdomen disclosed nothing abnormal. The reflexes normal. The impression was that of pansinusitis o right side, with marked involvement of the eth cells, retrobulbar abscess and possibly early osteomy of the skull bones. An abscess of the septum wa suspected at this time.

When the patient was seen again, between two three hours after the foregoing findings were reco the condition had grown rapidly worse both gene and locally. The swelling not only involved the e right side of the face but extended up over the head and the right side of the skull, included a the nose and reached backward to the ear. Both of the right eye were greatly swollen, and coul be separated enough to permit one to examine the fu The eyeball was fixed and proptosed, and the conjun was chemotic. The intranasal space on the right was totally occluded by edematous swelling of the e mucosa, including that covering the septum. The cheek was greatly swollen inside and outside. T were coarse tremors of the head. The patient comatose. He was incontinent and was vomiting. was also dehydrated.

Roentgen examination was limited to the skul cause of the extreme illness of the patient. A s tap was done; the spinal fluid cell count was 2 which 36 per cent were polymorphonuclear leuko and 64 per cent lymphocytes; the pressure was 180 of water, and the fluid was clear. Blood was t for culture, and Staphylococcus aureus grew.

On April 24 an external operation for drainage o frontal and ethmoid sinuses and the Caldwell-Luc o tion were done. A subperiosteal hematoma was f along the inner wall of the orbit; the frontal sinus filled with pus; the ethmoid cells contained pus granulation tissue, and there was necrosis of the walls. The incision in the canine fossa revealed the swollen tissues of the cheek had been separated the underlying bone. The finger could be passed t the soft parts to the lower end of the frontal inc on the side of the nose. The nasal mucosa wa swollen that it was not possible to view the interi the nose. The membrane did not shrink when tr with epinephrine hydrochloride.

After the operation the patient's condition was cr for four days, during which time he was comatose incontinent. On the fourth postoperative day the sur noticed at the time of the dressing of the wound the septum was thickened, boggy and fluctuant. immediately incised the septal mucosa on the left and evacuated a large abscess. The swelling of face had by this time greatly subsided. Later o

day the patient was much improved, having become y rational and able to take reasonably adequate ities of fluids and nourishing foods. Some visual on had returned to the right eye. During the next or so it became apparent that the abscess of the n required more drainage than it was getting h the small incision.

May 14, the septal incision was lengthened, and r was made backward along the base of the septum he floor of the nose, creating a large flap on one f the septum. No fragments of bone or cartilage seen. From the beginning the patient received num doses of sulfadiazine.

October 6, the frontal sinus was again exposed se of a persistent discharging fistulous tract at the angle. Granulations and scar tissue were removed, he bone was curetted. The fistulous tract per-

On January 10, 1942 another revision was done; ime both tables of most of the right side of the l bone, including all of the posterior wall of ontal sinus, were removed. The dura was normal earance. The outer or lateral half of the removed was dense and sclerotic; the inner or medial half soft and necrotic in spots. The scalp flap was d back into place over a through and through ubber drain, which protruded at both ends of the ntal incision. The wound healed completely and emained healed. The deformity is considerable, e contours can be restored by plastic surgery. ight optic nerve is completely atrophied. There is bridge deformity but no perforation of the septum.

COMMENT

scess of the nasal septum may result from tion anywhere in the neighboring tissues ccurs most frequently after accidental or cal trauma. The pus may be found on r both sides of the cartilaginous and bony ework. In both of the cases reported, ion on one side only was adequate. If sides of the septum are incised for drainage, ncisions should be made at different levels void perforation.

e cartilage apparently disintegrates, for mentation or sequestration of cartilage or is not always recognized at the time of, and following, surgical drainage. Abscess of the septum following trauma is preceded by the formation of a hematoma between the mucoperichondrium and the cartilage. Abscess following sinusitis probably is not preceded by the formation of hematoma. There was no hematoma in either of the cases reported here.

Abscess resulting from injuries accompanied by simple and compound fractures of the nasal bones must be a rare occurrence, since I have not observed it over a period of many years. Observations of persons injured in automobile accidents as they appear in the accident room of the hospital serve as the basis for this statement. It has been reported.

Abscess of the septum has been reported following endonasal antrostomy performed through the inferior meatus. This may possibly result from instrumental trauma to the lower part of the septum in the performance of the operation.

The one unfailing symptom of septal abscess is complete, usually bilateral, obstruction of nasal breathing. Tenderness, pain in nasal and orbital regions and swelling of the nose are also present. The mucosa covering the septum does not shrink when epinephrine hydrochloride or other vasoconstrictors are applied.

In reviewing the textbooks and other literature I was surprised to find so little written on abscess of the septum following sinusitis. I think that it is quite possible that sinusitis, especially ethmoiditis, has been frequently overlooked in the history and in the examination of patients with this lesion.

Suppurative involvement of an ethmoid cell in the crista galli with or without abscess of the septum poses an interesting speculation, as likewise does its management in a recognizable case.

More precise investigation of this subject is desirable.

421 Huguenot Street.

Case Reports

A GRAVE REACTION TO LOCALLY APPLIED TETRACAINE HYDROCHLOR

THOMAS HOLT, M.D., CHARLOTTESVILLE, VA.

For the past seven years tetracaine hydrochloride has been used by the members of the department of bronchoesophagology of the University of Virginia Hospital to obtain anesthesia of the mucosa of the upper air and food passages preparatory to endoscopic examination. There had never been any untoward reactions to the drug in our experience, and we felt that it constituted an ideal and safe topical anesthetic agent.

Our routine is to give pentobarbital sodium, 0.1 Gm., and morphine sulfate, 8 to 16 mg., forty-five minutes before taking the patient to the operating room. In the operating room a 2 per cent solution of tetracaine hydrochloride is sprayed into the pharynx with a hand atomizer twice every three minutes for a total of five times. The solution from the first spraying is swallowed in order to obtain some anesthesia of the upper part of the esophagus, and the solution from the remaining sprayings is expectorated after being allowed to remain in the pharynx for a minute or two. We have measured the total amount of solution of tetracaine hydrochloride after the total number of sprayings and it is always less than 4 cc.

The patient under discussion was a 60 year old Negro woman whom we were going to examine with the esophagoscope because of a traction diverticulum of the middle portion of the esophagus. She was considered to offer a good surgical risk. In the operating room the usual spraying routine was carried out, but within a few moments after the last spraying fine fibrillary twitchings of the fingers and of the entire upper extremities were noted. Within an extremely short interval, and before we realized exactly what was happening, these fibrillations developed into gross muscular spasms, and the patient became unconscious. She had a hard generalized convulsive seizure lasting two minutes, respirations ceased, and she became intensely cyanotic. Heart action, which was at first unaffected, became quite slow and later irregular. She was given 4 cc. of a 25 per cent solution of nikethamide intravenously, and inhalation of oxygen was started. After the convulsive seizure, artificial respiration was started, and her heart action and color improved. After a brief interval, she had another convulsive seizure, and heart action became undetectable. This seizure ceased after two minutes, and the patient was clinically dead; respirations were absent, there was no heart action, pupils were widely dilated, and there was complete muscular flaccidity. Within the briefest possible period we injected 1 cc. of a 1:1,000 solution of epinephrine hydrochloride and solution of metrazol (0.2 Gm.) into the external jugular vein, then 1 cc. of the solution of epinephrine hydrochloride directly into the left ventricle. Artificial respirations were continued, and oxygen was given under a slight positive pressure. After several minutes very faint and irregular heart beats were detected through the stethoscope. They rapidly improved in character, although not in rhythm, until they could be felt in the radial artery. It appeared that the patient was going to respond. However, another violent convulsion took place, necessitating the cessation of artificial respiration. This convulsion soon stopped, but as soon as we began artificial respiration again we apparently set off another seizure. It was then apparent that in order for this patient to secure any exchange of air it would be necessary to so depress her peripheral nervous system that sensory stimulations would not provoke clonic motor responses. Five cubic centimeters of a 2 per cent solution of pentothal sodium was then given intravenously, and immediately following this, artificial respiration was continued without setting off further convulsions. The patient then responded rapidly, the pulse became stronger, although it was irregular, and within fifteen minutes we were able to place her in a Drinker respirator. Within another five minutes, spontaneous breathing reappeared, and she was transferred from the respirator to her bed in the ward.

This reaction fits the classic picture of cocaine and procaine intoxications. The patient die a respiratory type of death, with heart action although markedly altered, continuing for some time. Salvation lies in controlling the seizures convulsions and thereby allowing sufficient exchange of air until the reaction wears off. In this case we were presented with the problem of controlling the convulsions of a patient who was moribund, which was done by administering intravenously a general anesthetic. It was a life-saving measure, because by controlling the hyperactive nervous system we were able to give her a sufficient exchange of air until her own respiratory center could take over. It is now our policy to have in the operating rooms at all times a sterile tray with the necessary equipment to give pentothal sodium intravenously without delay at the earliest sign of any idiosyncrasy.

From Department of Otolaryngology, University of Virginia Hospital.

BOECK'S SARCOID INVOLVING THE FACE AND THE LARYNX

RAYMOND S. ROSEDALE, M.D., CANTON, OHIO

is case of Boeck's sarcoid involving the and the larynx is being reported because e unusual distribution of the lesions and ularly because of the laryngeal involve-

Careful review of the *"Quarterly Cumu- Index Medicus"* has failed to disclose than two reports of Boeck's sarcoid of the x.

iferth[1] observed a patient with Boeck's id of the skin of the face, which occurred her with a fibrous swelling in the region of piglottis, partially obstructing the glottis. patient also had pulmonary involvement.

[2] in 1940 and again in 1942 fully de- d the case of a middle-aged Negro woman Boeck's sarcoid, who had multiple involve- of the upper respiratory tract. The pa- had lesions of the nose, the cheek, the nasal m, the lips, the hard palate, the soft palate, vula, the false vocal cords, the arytenoid ges and possibly the epiglottis. The dis- was symptomless except for epistaxis and eness. The patient also had involvement legs, the arms, the fingers and the nails, "characteristic lesions of Boeck's sarcoid." xternal lesions were without ulceration and rubbery in consistency. Tuberculin tests negative, and the character of the lesions demonstrated by histologic examination. tated that he was the first to describe clin- ultiple benign sarcoid lesions of the Boeck of the entire upper respiratory tract.

eck's sarcoid is known under a number of s. Some of these are: "lupus pernio," ier's sarcoid," "Besnier-Boeck disease," ier-Roussy sarcoid," "Besnier-Boeck lu- and "miliary lupoid."

ere has been a considerable accumulation erature concerning the origin and nature e disease. Without entering into the dis- n of the question, it may be stated that are some who believe the disease is tuber- s and others who attempt to refute this n. The solution of this problem is com- ed by the occasional observation of an acid- bacillus in the involved tissues, the some- association of tuberculous processes in pa- tients with Boeck's sarcoid and the presence or the absence of positive cutaneous reactions to tuberculin tests.

REPORT OF A CASE

Mrs. V. H., a Negro woman 42 years of age, a housewife, was referred by Dr. P. M. Ross, of Canton, Ohio, on June 27, 1944. She stated that, following an illness said to be influenza, which occurred six years previously, she had hoarseness which persisted, with exacerbations and slight remissions, becoming progressively worse, until the present time. The hoarseness was described as being worse in the mornings and in damp weather. After having her tonsils removed in 1940 she noted that an obstructive sensation developed

Fig. 1.—Patient with Boeck's sarcoid, showing the rubbery indurated lesions of the nose, the cheek and the lips.

in the nose and simultaneously a reddish nodule on the upper lip. The nodule she at first considered to be a "fever blister." However, instead of disappearing, it became firm and slightly violaceous and began to enlarge. In time, similar nodules appeared on the upper lip, and one on the lower lip. These involved the vermilion portion. Ulceration of these has never occurred. She stated that she had some swelling in the cervical region lasting three weeks in 1939. After the nodules appeared on the lips, she noticed some below the left eyelid and on the left cheek. Also one developed in the midportion of the back. These nodules have never been tender. They have progressively increased in size. She had some postnasal yellow discharge and some crusting of the nares up until about a year ago, at which time the nasal symptoms gradually disappeared. She denied that there had been tuberculosis in her immediate family or any contact

Seiferth: Benign Miliary Lupoid (Boeck's Tumor Upper Air Passages), Ztschr. f. Hals-, Nasen- renh. **46**:69, 1939; abstracted, Arch. Otolaryng. 3 (June) 1941.

Poe, D. L.: Sarcoidosis of the Larynx, Arch. yng. **32**:315 (Aug.) 1940; Benign Sarcoid of the Respiratory Tract, Ann. Otol., Rhin. & Laryng. (June) 1942.

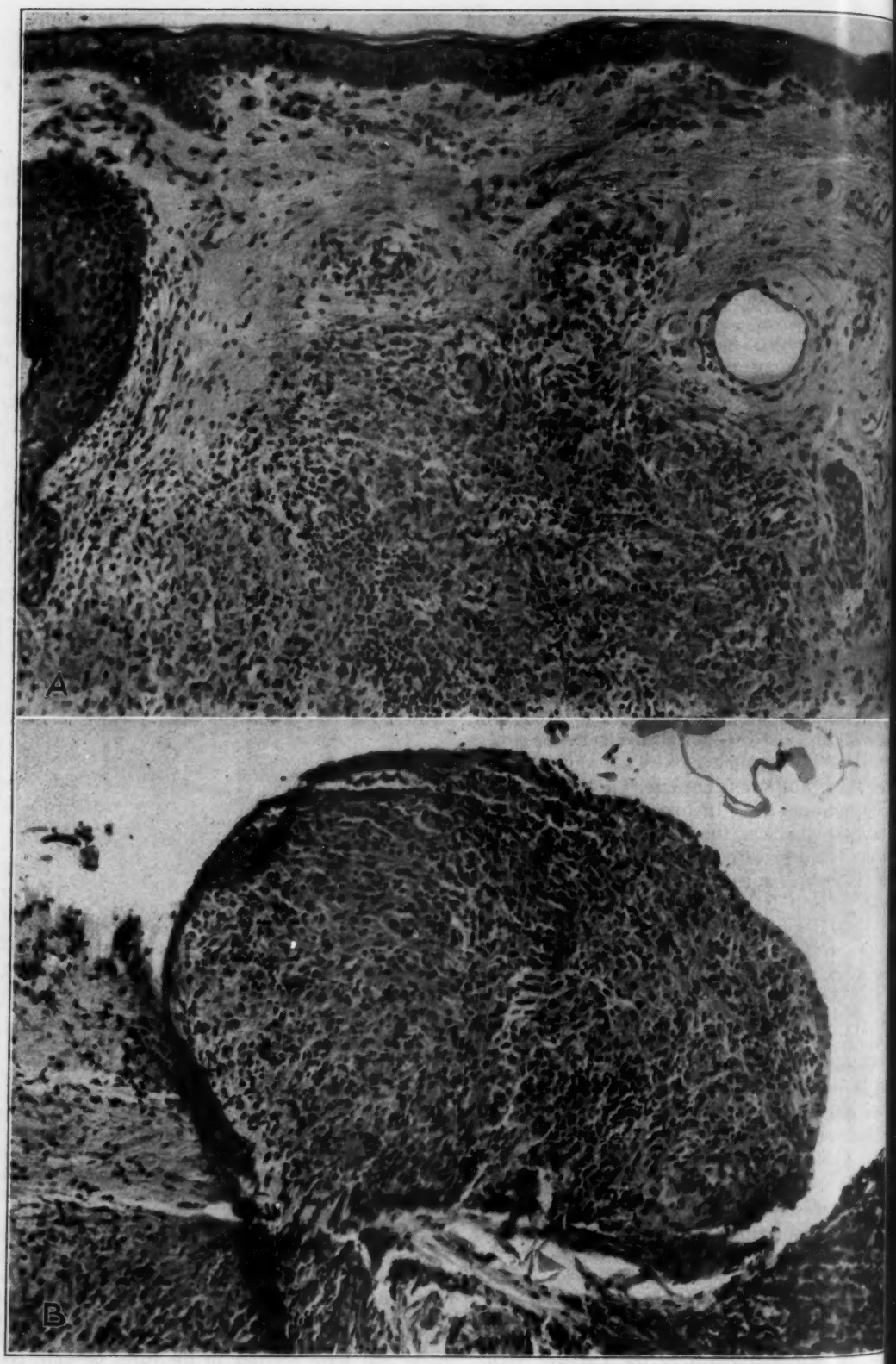


Fig. 2.—*A*, photomicrograph of a section from skin near the nose. Note epithelioid cells, invading lym cytes and giant cells. *B*, photomicrograph of tissue obtained in biopsy of the larynx. The microscopic pearance is strikingly similar to that found in the corium of the skin.

uberculous patients. She was born in Kentucky d always lived there or in this vicinity. There en no loss of weight or fever. The appetite was

patient was an obese Negro woman with nor- emperature and pulse rate. The outstanding features were dyspnea and hoarseness. The was high pitched and thin. The dyspnea was severe enough to be considered a stridor. the nasal vestibules, particularly the left, and skin over the left cheek there were some rounded firm violaceous nodules varying in size hat of a grain of wheat to larger than a pea. these nodules seemed to be circumscribed, they definitely fixed into the skin. Similar nodules on the upper and lower lips. The one on the lip had a rather flat top. A similar nodule was found in the interscapular region. The pupils rounded, and reacted to light and accommodation. was no demonstrable intranasal pathologic con- The mouth, the tongue, the teeth and the e were not remarkable.

ct laryngoscopy revealed an irregular, grossly ed, grayish, pink nonulcerative mass involving eral aspects of both vocal cords. This extended the false cords and presented into the anterior ssure. The glottis was reduced in size, and its was irregular. The movement of both cords ghly limited. A striking feature was the absence eremia in the nearby associated structures. There o palpable enlargement of the cervical lymph The blood count, the chemical findings in the nd the results of urinalysis were essentially nor- Tuberculin tests were negative. The report on enograms of the chest was as follows: "The nary fields are clear. The shadow of the left s increased in size with a suggestion of a large overlapping the aorta and pushing the trachea y to the right. The heart is within normal limits. orta is a trifle wide. The diaphragm is smooth tour and considerably elevated, due to abdominal re." Roentgenograms of the hands were reported owing no pathologic changes.

as the clinical impression that the patient had a oma, and the diagnoses of leprosy, Boeck's sar- nd Hodgkin's disease were entertained.

On June 29, direct laryngoscopy was done again. There were no new observations. Tissue was obtained from the granulomatous area of the left vocal cord and examined. At the same time a biopsy specimen was taken from one of the nodules of the face. The patient recovered uneventfully from the excision of tissues.

Microscopic examination of these tissues disclosed a strikingly similar pathologic process in both. The predominant feature was the presence of nests of rather large cells with fairly clear cytoplasm. The nuclei were rather light staining and moderately large. There was relatively little pleomorphism. In some instances there was some palisading of epithelioid cells. There were no areas of necrosis. There was some lymphocytic invasion. The stroma was fibrous in character. Blood vessels were not particularly numerous. There was a greater tendency for closer congregation of epithelial cells in smaller and less frequent areas in the specimen from the skin than in that from the larynx. Smears were made from the fresh specimens and examined for acid-fast bacilli. None were found. Sections were also suitably stained for acid-fast bacilli, but none were found. The patient's dyspnea became gradually worse, and on November 6 it was decided to do a permanent tracheotomy. During the tracheotomy a piece of the tracheal wall was removed and later examined microscopically. It did not present any pathologic change. The recovery of the patient has been uneventful, and from that date until the present time the only noticeable feature is the slight increase in size of the nodules on the lip.

SUMMARY

A patient presented involvements of the face and the larynx, which were histologically proved to be Boeck's sarcoid. Clinically, the lesions involved also the vestibules of the nose and the lips. The laryngeal lesion was obstructive. As far as is known, this is the third recorded instance of involvement of the larynx by Boeck's sarcoid.

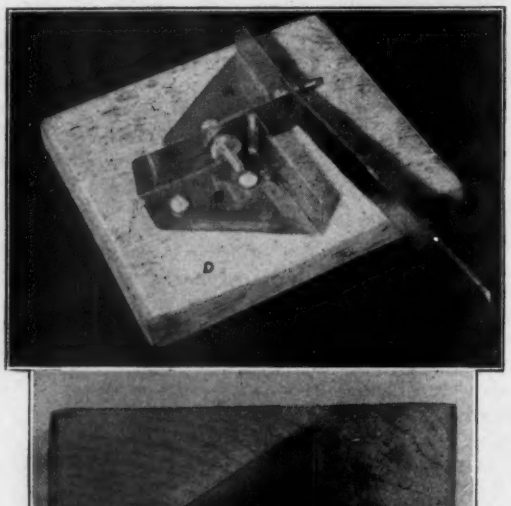
610 North Market Avenue.

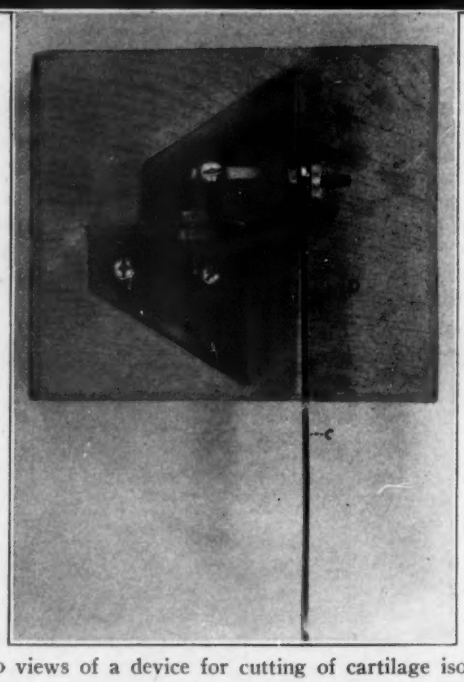
Clinical Notes

A DEVICE FOR CUTTING OF CARTILAGE ISOGRAFTS

JOSEPH STAGMAN, M.D., CHICAGO

When a cartilage isograft is to be implanted in the nose, as in a saddle nose defect, or in the ear, as in microtia or anotia, it is always time consuming to carve by hand an implant of exactly the right dimensions and form to fill the defect. This is accomplished by whittling off from a block of preserved rib cartilage, with a Bard-Parker knife, small amounts of cartilage at a time until the proper dimensions have been reached. To whittle a straight line for a nasal dorsum or a smooth thin piece for an aural implant is always slow and difficult.





Two views of a device for cutting of cartilage isografts.

The instrument shown in the accompanying illustration simplifies the fashioning of these cartilage isografts considerably. With it, a block of cartilage can be cut down to the right size and thickness rapidly. Then only a small amount of finishing by hand is necessary.

With the common paper cutter in mind, this device was designed and made with the assistance of Mr. Nathan Bagin.

It consists of two triangles of stainless steel, *A* and *B*, with the right angle portions of the triangle bent up perpendicularly, and a stainless steel knife attached to a block of wood, *D*. Triangle *B* is to the board and serves as a fixation point against which the cartilage can be placed. Triangle movable and adjustable and has two slots, one of is attached to triangle *B* by a thumb screw, the other is attached to the board by loosely tig bolts. The knife, *C*, is attached to triangle another thumb screw. Loosening of one thumb permits adjusting of the device for the width of ca desired, as the distance of the knife blade fr determines the width of the cartilage or its thic Loosening of the other thumb screw, attachin knife to the apparatus, permits removal of the for chemical sterilization. The rest of the devi be sterilized by autoclave.

It is hoped that this device will prove as use others as it has to us.

25 East Washington Street.

Progress in Otolaryngology

maries of the Bibliographic Material Available in the Field of Otolaryngology for 1944

THE PARANASAL SINUSES

SAMUEL SALINGER, M.D.
CHICAGO

(Concluded from Page 224)

SURGICAL PROCEDURES

llender and Snitman [68] state that radical pation of sinal mucosa is indicated in only ll minority of cases. In many instances this l procedure is based on roentgen findings or without the use of contrast mediums. logic examination of the tissue, however, reveals a status which, in their opinion, is ncapable of returning to normal if adequate age and ventilation are provided. They that many of the specimens show only rate edema and thickening, which in many are due in part to an allergic factor.

omment: While the authors rightly point he fact that in many cases radically extir- sinal mucosa gives evidence of being le of rehabilitation, they fail to indicate clearly how one can determine in advance type of case requires radical surgical treat- a contingency which they admit does arise.

mpet [69] believes that the operation of ro de Lima is best designed to eradicate ic disease of the maxillary, ethmoid and oid sinuses and cites 3 typical cases. The ic is without danger to vital structures, can ne painlessly and is followed by little dis- rt. The author describes the more essen- etails of the operation, which, as mentioned ously in these columns, is a transantral sphenoid operation with preservation of asoantral wall of the middle meatus.

amm [70] goes into considerable detail in dis- ng the various surgical procedures for the of chronic disease of the maxillary sinuses and comes to the conclusion that intranasal technics are to be preferred in all cases except those of large dental cyst, tumor, osteomyelitis and extensive tuberculosis. His objections to the Caldwell-Luc and Denker operations are numerous. He lists as frequent complications: temporary or permanent anesthesia, the formation of blind pockets within the sinus predisposing to reinfection and cystlike accumulations, interference with the blood and nerve supply of the teeth, and ingrowth of stratified epithelium from the oral cavity. He asserts that nearly all infected antrums can be adequately dealt with by way of intranasal openings, and he lists the various procedures that are classed as of this type, such as the Canfield, the modified Mikulicz and various modifications known as the Strumann, the Canfield, the Ballenger and the Halle. He feels that the success of these operations depends on the establishment of a permanent large window, readily accessible. This is accomplished through the removal of sufficient bone, especially the lower portion of the nasoantral wall, and the proper application of a mucosal flap taken from the nasal side of the wall.

Müller [71] describes a technic for injecting the second division of the fifth nerve to obtain anesthesia in preparation for a radical operation on the antrum, by a transzygomatic introduction of the needle in the angle formed by the frontal and temporal processes of the malar bone. The solution is injected first in the sphenopalatine fossa and then in the region of the maxillary tuberosity.

In preparation for radical operation on the maxillary sinus Gutiérrez and Carri [72] instil a 2 per cent solution of tetracaine hydrochloride with 1 cc. of a 1:1,000 solution of epinephrine

Hollender, A. R., and Snitman, M. E.: Nasal itis: Prognosis and Treatment Based on a More al Histopathologic Interpretation, Illinois M. J. 6 (Oct.) 1944.

Bompet, R.: Tratamiento quirúrgico de las pan- is, Bol. y trab., Soc. argent. de cirujanos **4**:937, Rev. Asoc. méd. argent. **58**:87 (March 15) 1944.

Stamm, C.: Intranasal Surgery on the Maxillary Eye, Ear, Nose & Throat Monthly **23**: 257) 1944.

71. Müller, F.: Aplicacao da anestesia regional epizigomatica do nervo maxilar superior no operacao radical do seio maxilar, Rev. paulista de med. **23**:346 (Dec.) 1943.

72. Gutiérrez, C. A., and Carri, V. R.: Anestesia loco-regional (por inyección) en las intervenciones del seno maxilar, Rev. otorrhinolaring. d. litoral **1**:76 (Sept.) 1941.

hydrochloride after preliminary irrigation, in addition to injecting the same solution into the infraorbital foramen. They state that with a preliminary injection of a preparation called "Escofedal," which contains scopolamine, a codeine derivative and racemic ephedrine, the procedure is entirely painless and without the usual postoperative neuralgia.

Rodriguez [73] records a case in which air embolism followed an attempted puncture of the antrum in an 18 year old girl. There was a history of an odontogenic infection with foul discharge which, despite a Caldwell-Luc operation, persisted. Because of the continued foul discharge, local tenderness and other symptoms, the author attempted puncture and irrigation. Considerable difficulty was encountered, and when some force was exerted the patient suddenly fell unconscious with contralateral hemiparesis, facial paralysis, aphasia and cyanosis of the contralateral arm. She was placed in the Trendelenburg position and given an injection of a solution containing caffeine. In about six minutes she began to move her limbs and speak incoherently with marked gesticulation. This stage of excitement lasted for ten minutes. Subsequently the patient was reoperated on under general anesthesia. The antrum was found restricted in size, with pus and degenerated mucosa. When an antrum needle was placed in position as in the previous attempt, it was seen that the point of the needle had penetrated the posterior wall, entering the pterygomaxillary fossa and probably entering one of the numerous veins found there. The patient recovered fully. The author ascribes the accident to a combination of narrowness of the vestibule, presence of a bony crest and condensing osteitis following the previous operation, all of which made the attempted puncture difficult.

Velasco [74] describes the de Lima operation or transantral ethmoidectomy, making a few minor suggestions of his own, and reports a series of 30 cases, in 77.2 per cent of which the operation was attended by a cure. He lists 2 cases in which postoperative transient facial palsy was noted, due to excess of local anesthesia, 1 case in which postoperative hemorrhage occurred and 2 cases in which infraorbital neuralgia yielded to vitamin therapy. Postoperative paresthesias disappeared in an average of forty-five days.

73. Rodriguez, C.: Embolia gaseosa producida en el transcurso de una punción de seno maxilar, Arch. venezol. Soc. de oto-rino-laryng., oftal., neurol. **4**:76 (June) 1943.

74. Velasco, R.: Estudio anatomico y clinico de la operacion de ermino de Lima, Rev. otorrhinolaring. **3**: 49 (Sept.) 1943.

The author emphasizes the fact that the Lima technic permits full visualization of ethmoid labyrinth, which is exenterated with destroying the nasoantral wall in the middle meatus. The nasal fossa remains anatomically perfect through preservation of its mucosa the middle turbinate. In 14.4 per cent of cases, however, it was impossible to open sphenoid sinus, and in 2.2 per cent the ethmoid labyrinth could not be cleaned out because bulging lacrimal nasal duct. Several drawings of anatomic specimens help to illuminate text.

Patterson [75] gives the details of his technic cleaning out the ethmoid and maxillary sinuses. The incision is made in the nasojugal fold beginning one-fourth inch (6.5 mm.) below and ternal to the internal canthus. The fibers of orbicularis muscle are separated by blunt dissection, exposing the margin of the orbit. The periosteum is incised and retracted as far as internal tarsal ligament and down as far as infraorbital foramen. The inner wall of orbit is exposed. The nasolacrimal duct is lated and mobilized. The periosteum along inner wall of the orbit is separated, and the ethmoid sinus is opened and cleaned including most of the lamina papyracea lacrimal bone. The mucosa lining the nose opened, which gives access to polyps situated the angle. The antrum is opened from and polypoid tissue removed. The anterior of the sphenoid sinus may be opened if necessary. The frontal sinus cannot be adequately through this approach but has to be opened through a separate incision. In closing orbicularis muscle is sutured to cover the and then the skin is closed.

The advantages claimed for this technic, which is amply illustrated in the article, are (1) mal bleeding, (2) less postoperative reaction (3) more prompt recovery.

Hargrove [76] follows Patterson with a detailed report of 28 consecutive cases in which latter's technic was applied with brilliant results.

Bergara [77] presents the details of his operation for chronic frontoethmoiditis, a procedure he described in great detail monograph issued in 1940.[78] Nothing new added.

75. Patterson, N.: Chronic Sinusitis with Polypi Lancet **1**:558 (April 29) 1944.

76. Hargrove, S. W. G.: Chronic Sinusitis Polypi: Results of Patterson's Operation, Lancet 560 (April 29) 1944.

77. Bergara, R. A.: Tratamiento quirúrgico frontoethmoiditis crónica por el método osteoplastico Rev. otorrinolaring. d. litoral **1**:246 (March) 19

Palma Guimarães [79] discusses the medico-
aspects of disfiguring scars of the supra-
l region resulting from surgical operation on
rontal sinuses. He goes back into history for
ences to the role of plastic or esthetic sur-
procedures and the responsibility of the
on in avoiding disfiguring scars. He also
legal authorities on the subject and cases
tigation in which rulings were obtained.
cites the Loundes Yates classification of
al scars from the esthetic point of view
discusses the merits of various approaches.
concludes with a denial of the modern
ncy to class the practice of surgery as a
r profession," preferring to support the age-
doctrine that medicine is a "liberal profes-
and therefore not subject to the legal
ictions that would apply to the former.

adbeer [80] reports a successful result in ex-
l frontal sinusotomy in which a cutaneous
taken from the thigh was used to line the
y enlarged nasofrontal duct and to cover
xposed orbit. It was held in place with a
ng of tulle gras, through which a rubber
age tube was passed. The wound was left
. After seven days, the packing and tube
removed, the redundant portion of the graft
excised and the wound closed. Subse-
tly the wound was reopened because of a
sting fistula. The cavity was found com-
ly lined with a smooth, thin, translucent
brane. Closure was effected, and six
hs later it was possible to pass a no. 14
ie into the newly lined cavity.

NONSURGICAL THERAPY

ccine and Drug Therapy.—Kolmer,[81] after
ty-five years of experience, is still favorably
ed toward active immunization with autog-
s vaccines against secondary bacterial in-
rs of the upper respiratory system. He
tains that the results are satisfactory in
erly selected patients but advises that local
logic conditions, such as deviation of a
m, chronic sinusitis, polyposis and vaso-
r rhinitis due to allergy, be properly taken
of by a qualified rhinologist. He insists on proper collection of the material for culture and cultivation in mediums adequate to insure growth of all the invaders. When the organisms are grown in broth mediums for five days a sufficient amount of exotoxins are produced to possess maximum vaccinogenic activity. Mixtures containing 1,000,000,000 killed bacteria are given every five to seven days in ascending doses depending on the reaction of the patient. He has found definite resistance to bacterial infection as a result of this therapy, and the immunity, as a rule, lasts for a year or more.

Further in the article, Dr. Kolmer expresses his views on the use of sulfonamide compounds, penicillin, tyrothricin and serums, which seem to coincide with the experience of others. He feels that more care should be taken in identifying the causative organism before administering a sulfonamide compound, since it is known that frequently one of these drugs is the most effective against certain particular bacteria.

The article covers the ground thoroughly and presents an excellent summary of present knowledge on this subject.

Lierle and Evers,[82] having experimented with various drugs on extirpated human mucosa, reveal the deleterious effects of certain solvents on the ciliary apparatus. Chlorobutanol used as a preservative slows or stops ciliary activity. Sulfanilamide, sulfathiazole and sulfadiazine used in powder form have no effect on the cilia. Saturated solutions of sulfanilamide seldom produce any permanent damage. However, an isotonic 5 per cent sodium sulfathiazole solution paralyzed the cilia, probably because of high p_H (10.17). A 2.5 per cent solution of sulfadiazine in triethanolamine and butyl parahydroxybenzoate stops cilia almost at once, but when washed, the cilia recover. The authors attribute the deleterious effect to the solvent.

Penicillin was found to be nonirritating to the mucosa when used in as high a concentration as 5,000 units per cubic centimeter.

Butler and Ivy [83] studied the effects of various vasoconstrictors on the nasal mucosa. The materials were introduced as volatile substances, sprays and drops, and the results were measured with a modification of the apparatus described by Sternstein and Schur.[84] Volatile inhalers and

Bergara, R. A.: Tratamiento quirúrgico de la
ethmoiditis crónica por el método osteoplástico,
os Aires, Alfredo Frascoli, 1940; cited by Salinger,[11]
6.

da Palma Guimarães, A.: Belesa, cirurgia e direito
oposito da visibilidade da cicatriz na incisão de
n-Ritter, Rev. brasil. de oto-rino-laryng. **12**:73
rch-April) 1944.

Bradbeer, W. H.: Skin Grafting in Frontal Sinus
tions, J. Laryng. & Otol. **59**:36 (Jan.) 1944.

Kolmer, J. A.: Chemotherapy and Biotherapy,
Otolaryng. **40**:17 (July) 1944.

82. Lierle, D. M., and Evers, L. B.: Effects of Certain Drugs upon Ciliary Activity of the Mucous Membrane of the Upper Respiratory Tract, Laryngoscope **54**:176 (April) 1944.

83. Butler, D. B., and Ivy, A. C.: Method of Application of Drugs to the Nasal Mucosa, Arch. Otolaryng. **39**:109 (Feb.) 1944.

84. Sternstein, H. J., and Schur, M. O.: Quantitative Study of Nasal Obstruction: A New Method, Arch. Otolaryng. **23**:475 (April) 1936.

sprays were far more effective than drops and at the same time caused less pathologic change in the tissues. The change produced in the mucosa after prolonged use of vasoconstrictors was investigated in a number of experimental animals. The tissues thus exposed were examined histologically after periods ranging from thirty to one hundred and eight days. These studies confirmed the conclusions mentioned.

Crowe [85] presents a résumé of his experience with the newer drugs in the treatment of pathologic conditions of the nose and throat. A 2.5 per cent solution of sulfadiazine in triethanolamine was used in the treatment of 1,500 patients with acute infection of the upper respiratory tract (common cold) during the past three years, with far better results than with any other form of therapy. Instillation of the solution is begun at the earliest appearance of symptoms of a cold and is repeated ten to twelve times daily for a few days and less frequently after that. If continued for a month this treatment often clears up chronic nasopharyngitis. Only 5 per cent of the patients manifested allergy to the drug, which then had to be withdrawn.

To rid the patient permanently of lymphoid tissue, which harbors bacteria and predisposes to recurrences, Crowe has been using radon or radium as described in a previous article, with good results. Since high concentrations of radon are not universally available, the author has tried a 50 mg. applicator of monel metal and found it equally serviceable. In a series of 259 patients the results were as good as those formerly obtained with the radon applicator. The average period of the single treatment was six and six-tenths minutes, and the treatment was repeated every few days as required. The effect in cases of chronic otitis has been striking. It is important in all such cases to eliminate infections in the teeth, the tonsils and the sinuses.

Tyrothricin has been found effective when applied locally to infected sinuses and to sinuses that have been operated on. It has a definite bacteriologic effect on gram-positive bacteria. Penicillin is more effective in penetrating the tissues and has the advantage of being available for intravenous and intramuscular administration.

Summarizing his experience, Dr. Crowe emphasizes the importance of knowing the bacterial invader and then applying the drug known to have specific affinity for it. With acute spreading infections the sulfonamide compo given by mouth, and penicillin, are both factory. With chronic infections it is nece in addition to bring the drug into direct co with the infected tissues—hence the import of knowing how to apply tyrothricin and cillin.

In a purely clinical study, uncontrolle laboratory procedures, Whalen [86] came to conclusion that the local use of the sulfona compounds in acute infections of the sinuses the upper respiratory tract is of no pra value. He found that the addition of "we agents," such as an aerosol, Tergitol and Oc contributed nothing to the effectiveness o drug; nor was the introduction of the sol into the sinus by displacement or by d instillation of any value. It is his belief sulfonamide compounds to be effective in sinuses must be given internally (not i muscularly in serious cases) and in such amo as will maintain a fairly high concentratio the blood. The dose should vary with severity of the infection: from ¼ grain (16 per pound of body weight per day as a mini to 1 grain (0.06 Gm.) as a maximum. Alth he recommends sulfadiazine as the drug of ch he nevertheless advises ascertaining the dominant organism by culture. Naturally, administration of these drugs must be contro by frequent studies of the blood and the u

The author feels that the pendulum has sw too far to the conservative side in the the of sinusitis, as evidenced by the recurring n of the malady. He believes that in many c the infected sinus should be dealt with surgic He reasons by analogy with osteomyelitis, gical mastoiditis and abscess of the lung, which sulfonamide drugs cannot be expecte yield results unless free drainage is establi Simularly, many infected sinuses require sur drainage before one can expect a cure. In tients with such sinuses, conservative treat leads merely to a temporary recession of sy toms.

Hamilton, George, Simon and Turnbu present some scientific data bearing on sulfonamide compounds and their structur combination with various stabilizers. T claim that sodium sulfate with glycerin m an efficient stabilizer, preventing deterior

85. Crowe, S. J.: The Local Use of Sulfadiazine Solution, Radon, Tyrothricin and Penicillin in Otolaryngology, Ann. Otol., Rhin. & Laryng. **53**:227 (June) 1944.

86. Whalen, E. J.: Sulfonamide Compounds in Treatment of Infections of the Nasal Sinuses, A Otolaryng. **40**:481 (Dec.) 1944.

87. Hamilton, W. F.; George, M. F., Jr.; Simon and Turnbull, F. M.: Vasosulfa Compounds, J. Pharm. A. **33**:142 (May) 1944.

ecipitation and rendering the resultant mix-
more effective and safer when used locally
the nasal passages. Four such compounds
resented.

e and Diamond [88] describe a case in which
ic suppurative maxillary sinusitis with
osis, shown roentgenographically with con-
mediums, yielded to local penicillin ther-
Gram-positive Staphylococcus aureus and
ylococcus albus were isolated from the
ion. Both antrums were punctured with
needles, which were allowed to remain
ce twenty-four hours. Penicillin in sterile
ic solution of sodium chloride, 1,000 units
ubic centimeter, was injected 5 cc. at a time
three hours for eight doses. The stilet
replaced in each needle immediately after
stillation, and the patient was kept in the
ht position. On the third and fourth days
patient blew out fragments of polypoid
. On the sixth day the nose was almost
of pus. A submucous resection of the
m was performed, and residual polyps were
ved from the middle meatus. Cultures
six days later were negative. Roentgen-
ns made with use of a contrast medium
d some filling defects still remaining. The
y-four hour penicillin treatment was re-
d. Seven days later the irrigation fluid
ned clear. Cultures were negative. Roent-
grams again revealed one antrum completely
al and the other with only minimal evidence
perplasia.

servation for the next two weeks revealed
idence of a return of the infection.

er a two year period Wiesenfeld [89] treated
nselected patients for subacute and chronic
sinusitis with a suspension of sulfadiazine
reports a cure or marked improvement
n three weeks in 83 per cent. Over 90
cent of the patients had infected antrums.
antrums were irrigated and after drying
ved an instillation of a "25 per cent sulfa-
ne water soluble suspension containing one-
h per cent neosynephrine hydrochloride."
e other sinuses were involved, the solution
introduced by displacement. No other
ment was used except the application of
shrinking agents. The patients whose
itis failed to respond to the therapy were
d to be allergic or to have involvement
advanced to the stage where a resort to operation was indicated. The author fails to separate the cases of subacute from the cases of chronic rhinosinusitis, so that it is difficult to determine in which group the results were more favorable.

Cawsten [90] claims that it is unnatural for fluids to enter the nasal passages, and he therefore favors the use of medicaments applied in powder form. He recommends a powder called propamidine (4,4'-diamidino-1, 3-diphenoxypropane dihydrochloride) which has been used with good effect in the treatment of microbic infections of the skin.

Journals from the continent have been slow in arriving, and therefore some of the material is out of date. Singer's report [91] on the local use of a 5 per cent suspension of sulfathiazole in water seems ancient. He reports having used the suspension in the maxillary sinus by instillation after irrigation, with satisfactory results. No statistics are furnished as to types of sinusitis treated, bacteria isolated or results observed in follow-up.

Weille [92] calls attention to good results in many cases of common cold from the use of a 2.5 per cent solution of sulfadiazine in 8 per cent triethanolamine (Pickrell's solution), which was sprayed into the nose and throat with a no. 251 DeVilbiss atomizer every two hours. It may be alternated with a shrinking agent, such as 0.1 per cent naphthylmethylimidazoline hydrochloride (Privine) or 0.25 per cent neosynephrine hydrochloride, but the two should not be used at the same time.

Cecil, Plummer and Smillie [93] after a careful analysis of a group of subjects treated with sulfadiazine for common colds come to the conclusion that routine employment of this drug is not desirable but that its use has a definite value in selected cases as a protection against secondary infection. Seventy-two colds in 66 different persons were followed clinically and bacteriologically; sulfadiazine was given for 48 of the colds, 3 Gm. daily by mouth for four days; the other 24 colds served as controls.

Following the use of sulfadiazine, the nasopharyngeal flora as observed by serial cultures showed a uniform decrease in total number of

Sale, G. G., and Diamond, E. H.: Chronic Sup-
ve Maxillary Sinusitis Treated Locally with Peni-
by a New Method, Arch. Otolaryng. **40**:406
.) 1944.

Wiesenfeld, I. H.: Treatment of Rhinosinusitis
Local Sulfadiazine Suspensions, Permanente Found.
ull. **2**:179 (Oct.) 1944.

90. Cawsten, F. G.: Dry Powder and Nasal Sinusitis, Clin. J. **73**:227 (Nov.-Dec.) 1944.

91. Singer, R.: Local Application of Sulfathiazole, Pract. oto-rhino-laryng. **4**:249, 1942.

92. Weille, F. L.: Treatment of Common Ear, Nose and Throat Problems by the General Practitioner, M. Clin. North America **28**:1108 (Sept.) 1944.

93. Cecil, R. L.; Plummer, N., and Smillie, W. G.: Sulfadiazine in the Treatment of the Common Cold, J. A. M. A. **124**:8 (Jan. 1) 1944.

organisms and a check of the growth of pathogens.

The clinical course of the treated colds showed no striking difference from that of the controls; however, there appeared to be some amelioration of symptoms due to control of secondary bacterial infection.

Giesman [94] poses the question "Is the intranasal administration of a medicated oil within the limits of normal therapeutic dosage necessarily a dangerous clinical procedure?" and then submits clinical evidence of an experimental nature to show that the answer depends on how the oil is introduced. Thirty-one patients were selected for testing; their ages ranged from 6½ to 66 years, and the oils employed were sesame oil and medicated liquid petrolatum with iodized oil in varying percentages. Roentgenograms showed the oil coursing down the respiratory tract. The author concludes that the decisive factor determining aspiration of oil is the position of the head; the danger arises when the head is inclined backward from the erect, and it increases in direct ratio to the degree of posterior inclination. He states that "there is no danger when the head is held straight or bent forward, even when massive doses many times the normal therapeutic dose are employed."

Cowan and Diehl [95] report that the results from the use of a commercial "cold" or "influenza" vaccine as a nasal spray were unsatisfactory so far as the prevention of colds was concerned; 321 students participated in the survey, a number of them as controls using a sterile isotonic solution of sodium chloride colored to resemble the vaccine. No significant difference was noted between the experimental and the control group in number of colds. Neither was any difference discovered in the percentage or the degree of complications.

Irrigation by Displacement.—Butler, Greenwood and Ivy [96] report their results in a series of 125 patients with chronic sinus disease treated in a high altitude chamber by a reduction of air pressure. All of the patients had been proved to have sinus disease and had been under treatment for some time without results, and some (31.2 per cent) had been subj to various surgical procedures. The av duration of the disease had been nine and half years. Treatment consisted of rapid de pression in the air chamber to 522.6 m mercury, equivalent to an altitude of 10,00 (about 3,000 meters) at the rate of 5,00 (about 1,500 meters) per minute, followe slow recompression at the rate of 700 (about 215 meters) per second. As a rul patient was brought back to 5,000 or 6,00 Alternately then the pressure was changed 5,000 to 10,000 feet for a period of forty utes, after which slow decompression to g level completed the treatment. The numb "ascents" included in one treatment varied four to six, depending on the patient's rea especially his ability to maintain the paten the eustachian tubes. Of the patients, 89. cent reported subjective improvement va from "fair" in 21 per cent to "excellent" in per cent. Treatments were given at the of 1 to 4 a week for an average of 18.1 ments per patient.

Objective improvement was noted in 71. cent of 31 patients through repeated rhino examinations. Of 29 patients followed by roentgen studies with radiopaque oil, 58. cent showed improvement.

The rationale of the treatment is based o theory that the lowered air pressure facil the drainage of the sinuses and improves ve tion. A simple diagram accompanying th ticle explains these principles.

Russell [97a] has found the Proetz metho displacement a satisfactory therapeutic pr ure for a variety of conditions. Reviewin experience during the past ten years, he cusses the probable modus operandi of th placing solution, a slightly hypertonic so of ephedrine hydrochloride in isotonic so of sodium chloride.

In a number of cases an initial intole was noted, the patient manifesting a toxi action, which the author ascribes to s release to toxins from the infected area person who is particularly sensitive. He that many persons become inordinately i tated by an ordinary head cold.

Postural intolerance, manifested by dizz headache and nausea, was frequently n more particularly in patients with chronic sitis and least frequently in children. Such

94. Giesman, B. L.: Proper and Improper Administration of Oily Nasal Sprays, Arch. Otolaryng. **39**:124 (Feb.) 1944.

95. Cowan, D. W., and Diehl, H. S.: Intranasal Vaccine for the Prevention of Colds, Ann. Otol., Rhin. & Laryng. **53**:286 (June) 1944.

96. Butler, D. B.; Greenwood, G. J., and Ivy, A. C.: Reduced Atmospheric Pressure as a Form of Treatment for Paranasal Sinusitis, Arch. Otolaryng. **40**:266 (Oct.) 1944.

97. (*a*) Russell, B.: Ten Years' Experience Displacement Treatment, J. Laryng. & Otol. (Aug.) 1943. (*b*) Parkinson, S. N.: Va Treatment of Nasal Sinuses, ibid. **44**:611 (Oct.)

may be obviated by resorting to the Par- [illegible] position, although this too has occa- [illegible]ly been followed by the same sort of re- [illegible]. The author states that these reactions [illegible]ear after the first few treatments.

[illegible]placement is suggested as a valuable adju- [illegible]to other therapy when used, for instance, [illegible]inary to short wave therapy and prior [illegible]erative procedures. The author dismisses [illegible]ion of the eustachian tube and middle ear [illegible]h displacement as a highly improbable [illegible]ication.

[illegible]ward displacement for acute conditions, he [illegible]vorably inclined, having employed it on [illegible]lf with gratifying results. He even be- that when employed at frequent intervals [illegible]y be the means of aborting impending acute [illegible] media.

[illegible]placement was found to be of value in [illegible]in eye troubles," such as blurring of vision [illegible]sudden blindness, especially when these [illegible] associated with headaches, all due, of [illegible], to edema extending to the orbit from [illegible]sphenoethmoid area. Other conditions [illegible]oned as being more or less favorably influ- by the displacement therapy are allergy, [illegible] alone or associated with inflammation, [illegible]a, retention of sinal secretions and sore [illegible] due to irritation caused by sinal secre-

[illegible]the discussion which followed there was [illegible] disagreement as to the advisability of [illegible]displacement in treatment for acute condi- Hogg stated that in his experience it [illegible]efinitely harmful.

[illegible]lying to a query as to differentiating al- [illegible]from nonallergic conditions, Russell stated [illegible]hile in some cases it was difficult to inter- [illegible]he responses, he was in most cases able [illegible]ake a definite diagnosis by means of [illegible]ous tests, the history and the cytologic [illegible]ce. A contrast medium could be a very [illegible] adjunct in diagnosis if one became accus- [illegible] to using it frequently and therefore fa- [illegible] with its appearance in the films.

[illegible]ch[98] believes that by inducing hyper- [illegible]within the nasal chambers one can influ- [illegible]favorably acute or chronic sinusitis in [illegible] drainage and ventilation are impeded by [illegible]g of the mucosa. He advocates the use [illegible]s suction by means of a rubber bulb at- [illegible] to a glass nozzle. Also be believes in [illegible]ficacy of volatile menthol and thymol in [illegible]n to the usual vasoconstrictors. (Com-

[illegible]lesch, J.: The Treatment of the Sinuses, M. [illegible]10:396 (Dec. 22) 1943.

ment: Needless to say, mass suction has been looked on with disfavor by many outstanding rhinologists in this country. S. S.)

Fox[99] reports effective results from displacement therapy with vegetable oil in 97 per cent of more than 1,000 cases of acute rhinitis, associated with acute sinusitis in many instances. Five cubic centimeters of the oil is used in each side of the nose, and the treatment may be repeated, although the author holds one treatment is usually sufficient. The author believes that the oil is practically specific for the virus that causes colds.

Guerra[100] reports good results in chronic suppurative maxillary sinusitis treated through puncture and irrigation with potassium permanganate in 1:5,000 solution followed by instillation of 10 to 15 cc. of Cariogon, a soluble derivative of copaiba. He recommends semiweekly treatments and states a cure can be obtained in six to seven weeks.

Roentgen Therapy.—Christensen[101] shows a special adapter for irradiating the sinuses with which it is possible to expose all of the sinuses or any number of them at one time, thus avoiding overlapping fields. Roentgen therapy is not indicated in patients with marked septal deformity, blocking of drainage by enlarged turbinates, polyposis, empyema and sinusitis of dental origin. Its chief service is in cases of chronic hyperplasia. The technic employed by the author is explained in detail, with adequate illustrations. The average dose of a single treatment is 100 roentgens, and the treatment is usually repeated three or four times at weekly intervals. The author states that recurrences may be encountered, since the roentgen treatment does not confer immunity.

The author also has found that fluoroscopy of the sinuses may yield a good deal of information as to the status of the cavities but requires practice.

Munson and Munson[102] state that the effects of irradiation are much more dramatic in acute than in chronic sinusitis. They attribute this to the selective action of the rays on the leukocytes, leading to a reduction in the thickness of the acutely swollen mucosa and an

99. Fox, F. G.: Acute Rhinitis and Sinusitis: Suction Displacement Treatment with Vegetable Oils, Mil. Surgeon **95**:56 (July) 1944.

100. Guerra, J.: Empiema maxilar crónico: Tratamiento, Médica, Matanzas **3**:96 (May-June) 1944.

101. Christensen, F. C.: Ronetgen Therapy of Sinusitis with Special Adapter, Radiology **43**:21 (July) 1944.

102. Munson, F. T., and Munson, H. T.: X-Ray Treatment of Sinusitis, Am. J. Surg. **65**:95 (July) 1944.

increase in the vascular supply facilitating drainage. The relief from pain is often marked and prompt.

Finocchiaro and Pugliesi [103] call attention to their excellent results in chronic sinusitis, which were achieved by instilling an iodized solution and then immediately irradiating the sinus with roentgen rays. The solution was a 5 per cent colloidal silver (collargol). The dose of roentgen radiation was in inverse proportion to the acuteness of the process, the more chronic type requiring the larger doses. Citing a number of articles from the literature, the authors state that the effectiveness of the treatment is due to the fact that the roentgen rays on their absorption activate the iodine in the solution, thus prolonging its action within the tissues. Direct instillation is used for the antrum and displacement for the other sinuses.

CLINICAL CONSIDERATIONS

General Considerations.—A symposium covering the essential facts about sinusitis was presented to the staff of the Mayo Clinic by the members of the otorhinolaryngologic group, headed by H. I. Lillie.[104] Dr Lillie directed attention to misinformation given the general public by press and radio, causing in the minds of a great part of the laity a confusion which is only accentuated by lack of knowledge or of interest in the subject on the part of many physicians engaged in general practice.

The symposium covered the essential points in the anatomy and the physiology of the sinuses, the pathologic changes resulting from infection, the symptoms and the diagnostic criteria, the roentgenologic aspects and the usual therapeutic procedures according to indications.

It is interesting to note the conservative attitude toward therapy when the sinusitis is in the acute stages, particularly with reference to early puncture and lavage or any other traumatizing procedure. Likewise, the use of a vasoconstrictor in combination with a sulfonamide drug is decried because of the irritating effects of the latter and the vasodilatation which follows the initial constriction. In the subacute stage relief has been experienced following the use of the Dowling pack combined with mild spot suction.

Due emphasis is laid on necessity of di ing the allergic factors frequently found in ciation with chronic or recurring sinus di

The entire symposium is characterized b simplicity and the directness of the state made by the collaborators, all of which based on sound common sense.

Hilding [105] summarizes the known facts cerning the common cold and offers some vations pertaining to the pathologic aspect the therapy. The common cold is a wides epidemic contagious disease occurring i climates and especially in the autumn and months. It is spread by droplet infectio can be controlled by isolation of those who it. It is caused by a specific virus and is followed by complications due to secondary terial invaders. Chilling and exposure are logic factors, probably because of the prol reduced temperature of the nasal mucosa. munity from attacks is usually brief. V nation is unsuccessful, apparently because the virus and the bacteria have such poor genic properties. Prevention by giving mins or through the so-called "hard processes" is also unsuccessful.

The local pathologic process centers injury to the epithelium, the toxins presu acting directly on the epithelial cells, and sists in destruction of the superficial There is a marked submucosal cellular rea The secretion increases tremendously in v and contains a lower percentage of There is some indication that the lysozyme tent decreases even before the volume incr The change in p_H, if any, is small, and toward the alkaline side.

Numerous slides are presented, showing progressive changes in the mucosa, such as edema, necrosis of epithelial cells, fragm tion, vacuolation, disarrangement of all ation and other changes due to the action toxins.

Treatment is mainly symptomatic and rected at the prevention of complications.

Experiments with rabbits were perform Rosedale [106] with the idea of discoveri possible, the influence of temperature an midity on the course of purulent sinusitis. antrums of 20 rabbits, divided into g were infected by injecting a suspension o

103. Finocchiaro, M., and Pugliesi, J.: Iodo-roentgenterapia das sinusites, An. paulist de med. e cir. **46**: 267 (Oct.) 1943.

104. Lillie, H. I.; Lake, C. F.; Thornell, W. C.; Hallberg, O. E.; Williams, H. L., and Hempstead, B. E.: Symposium on Diseases of the Paranasal Sinuses, Proc. Staff Meet., Mayo Clin. **19**:465 (Sept. 20) 1944.

105. Hilding, A. C.: Summary of Some Facts Concerning the Common Cold, Ann. Otol. & Laryng. **53**:444 (Sept.) 1944.

106. Rosedale, R. S.: The Effects of Various binations of Temperature and Humidity on Arti Induced Sinusitis in Rabbits, Ann. Otol., R Laryng. **53**:144 (March) 1944.

5,000,000 each of Streptococcus viridans, ylococcus nonhaemolyticus and Pneumo- s type III. A specially constructed cham- was employed, in which it was possible to ol the temperature and the humidity, and roup of animals was placed therein for ds of two weeks, after which they were ved, killed, and their heads sectioned for logic study.

e different combinations of temperature humidity were employed, including the um one of 70 F. dry bulb, 48 F. wet bulb, a relative humidity of 50 per cent. The of this study showed that the animals the least destructive changes within the ed sinuses were in the group that was cted to the optimum conditions just men- d. The next least affected were those in roup that lived in a cool, dry atmosphere: ically, a temperature of 53 F. dry bulb. wet bulb, and a relative humidity of 45 ent. The most destructive changes were ntered in the animals of group IV, in which emperature was 90 F. dry bulb, 60 F. wet with a relative humidity of 12 per cent, is, a hot and relatively dry atmosphere.

hile the author does not consider that he proved anything by comparing these labo- y experiments with conditions obtaining g human beings, he hopes the data pre- d may be the forerunner of further work these lines, which may lead to definite usions as to the influence of climate on dis- of the accessory sinuses.

a discussion of chronic diseases of the the nose and the throat, Heatly[107] devotes pages to a brief consideration of chronic itis. He mentions three principal types, uppurative, the hyperplastic and the mixed in which allergy is a factor. The history, ocal examination, the study of roentgeno- s and the histologic examination of secre- are mentioned as necessary in the diag- . Treatment generally embraces care of constitutional states as may be the under- or the contributory factors, elimination al obstructive lesions, careful local treat- and surgical intervention as necessary, on an adequate study of the individual He cautions against operating for the of asthma except in those cases in which athologic condition of the sinuses warrants

Ford[108] has observed 7 women in whom a variety of nervous disorders yielded to adequate elimination of a focus of sinusitis. In most of them the symptoms presented included nervousness, exhaustion, depression, headaches, impairment of vision and loss of weight. Frequently there was no history of sinus trouble, although careful questioning could usually elicit such items as frequent colds, a previous attack of influenza, nasal obstruction or discharge.

In all of the cases the results of careful intranasal therapy were most gratifying.[109]

In a rather sketchy article Cawston[110] suggests several diagnostic signs pointing to previously undetected chronic sinusitis, which he claims may be the cause of a wide variety of disorders. Deafness of the left ear may be due to left-sided sinus infection induced by exposure of that side of the face at night. Tinnitus associated with bad weather also suggests a sinus infection as the focus. The author advises careful examination of the teeth, a study of the bacterial flora and strengthening the resistance through the use of sulfonamide compounds, vitamins and vaccines.

Maxillary Sinusitis Associated with Dental and Other Infections with Foreign Body.—Austmann[111] analyzes his results in consecutive maxillary sinuses examined at a military hospital. In 227 men he found 259 dark antrums; i. e., in 32 men the involvement was bilateral, and in the rest it was unilateral. Roentgen examinations were employed to confirm or refute evidence furnished by transillumination, and when shown to be abnormal these antrums were irrigated via puncture of the inferior meatus. One hundred and fifty antrums that were irrigated were shown to be uninvolved so far as pus or shreds were concerned and were declared free from disease. Of the 92 diseased sinuses, 63 were treated by irrigation and then by instillation of a 10 per cent solution of sulfathiazole in glycerin. Eleven of these failed to clear up. Five patients whose antrums failed to clear up on twelve to twenty irrigations were hospitalized and given sulfathiazole by mouth in addi-

Heatly, C. A.: Chronic Diseases of the Nose, t and Ear, M. Clin. North America **28**:330 ch) 1944.

108. Ford, R.: Chronic Ill Health Due to Paranasal Sinusitis, Practitioner **152**:174 (March) 1944.

109. Ford, R.: Migraine and Chronic Headache Relieved by Drainage of the Paranasal Sinuses, Clin. J. **73**:20 (Jan.-Feb.) 1944.

110. Cawston, F. G.: Signs and Symptoms of an Infected Nasal Sinus, South African M. J. **17**:362 (Dec. 11) 1943.

111. Austmann, K. J.: Maxillary Sinuses and Treatments: A Survey of 1,000 Consecutive Maxillary Sinuses at Petawawa Military Hospital, J. Canad. M. Serv. **1**:26 (Nov.) 1943.

tion to being treated by daily irrigation and instillation. In 4 of these the condition finally resolved.

Cotten [112] summarizes his results in a series of 659 patients with maxillary sinusitis. In 551 the condition cleared up under a combination of local therapy, use of vaccines, irrigations and general treatment. Eighty-seven were operated on by antrostomy; 66 of them recovered, whereas 21 underwent later a Caldwell-Luc operation or refused further surgical treatment.

Hill [113] states the case clearly in his own summary: Most cases of alveolar fistula are complicated by infection of the antrum. Intranasal drainage may result in spontaneous closure of a small fistula. Those of longer duration will require more radical procedures. The Caldwell-Luc operation should eliminate the sinus infection, and it may be combined with a plastic operation to close the fistula or it may be followed by such a procedure. A number of acceptable technics are presented by the author, all of which are adequately illustrated.

Radner and Pinkerton [114] report a case of that rare condition tuberculosis of the antrum. The patient was a Japanese man aged 20, who was seen after several episodes of hemoptysis. A diagnosis of pulmonary tuberculosis was made. Despite clinical improvement, the sputum still contained bacilli. Later pain and tenderness developed over the left antrum. Roentgen studies revealed moderate thickening of the mucosa, but the washings from the sinus contained nothing indicating disease. Several months later washings from both antrums revealed acid-fast bacteria on culture. Bilateral nasoantral resection was done. Both antrums contained white creamy pus and hyperplastic mucosa. Animal inoculations with washings and tissue from the antrums gave positive results. The recovery was slow with intermittent recurrence of the sinal discharge and an intercurrent infection of the ear. Although the sinuses seemed to clear up, it was the opinion of the authors that the ear was still infected with tubercle bacilli.

Pleasants [115] emphasizes the need of taking occlusal films in certain cases in which the pathologic change is not clear. A case in point cited: A man of 29 who complained of recurring painful swelling of the face with a discharge from the mouth had his molar removed, without being relieved of his symptoms. A fistulous tract was found leading deeply toward the antrum, and in the occlusal film it was seen to terminate in a sac containing an unerupted supernumerary molar tooth. A sublabial approach gave access to the well developed molar tooth, which was found to be developed in a cystic membrane communicating with the fistulous tract, all of which were excised. The antral mucosa was unaffected and the floor was left undisturbed.

Rosenzvit [116] reports a case of cacosmia of one year's duration in a 46 year old woman in whom all the usual causes were excluded. It proved to be due to an antral rhinolith, which was diagnosed by roentgenogram and was removed through a sublabial antrostomy. The concretion measured 6 by 16 mm. and was almost black. It consisted of layers of calcareous material around a granite-like central core. The author also reports a case of cacosmia in a 10 year old child which was due to an encysted shoe button found in the region of the posterior choanae.

Disease of the Frontal, Ethmoid and Sphenoid Sinuses.—Barry [117] reports the following case. Thrombosis of a cavernous sinus occurred in a boy of 16, induced by picking on a nasal furuncle. The thrombosis reacted so favorably to treatment with sulfonamide compounds and spontaneous emptying of an orbital abscess that the patient was discharged from the hospital. A month later he was readmitted with symptoms of meningitis following a cold contracted on a hunting trip. Despite continued use of the sulfonamide compounds, the patient died about ten days later. Autopsy revealed pansinusitis with osteomyelitis. The immediate cause of death was given as acute myocarditis rather than chronic basilar meningitis, which was minimal. The only question in this case is whether the osteomyelitis arose from the infection of the frontal sinus or was metastatic from the previous septicemia.

Altavista [118] describes a case in which frontal sinusitis in a young man of 19 was untreated

112. Cotten, W. F.: Maxillary Sinusitis, Mississippi Doctor **21**:276 (March) 1944.

113. Hill, F. T.: Management of the Alveolar Fistula, Arch. Otolaryng. **40**:167 (Sept.) 1944.

114. Radner, D. B., and Pinkerton, F. J.: Tuberculosis of the Antrum: Report of a Case, Am. Rev. Tuberc. **50**:313 (Oct.) 1944.

115. Pleasants, J. E.: Cyst in Sinus Containing Supernumerary Molar, Bull. U. S. Army M. Dept., March 1944, no. 74, p. 107.

116. Rosenzvit, A.: Contribución al estudio de la cacosmia: Cálculos en seno maxilar y cavum; antrolito y rinolito posterior, Rev. otorrinolaring. **1**:98 (Sept.) 1941.

117. Barry, W. B.: Thrombosis of the Cavernous Sinus, Arch. Otolaryng. **40**:299 (Oct.) 1944.

118. Altavista, A. E.: Forma poco frecuente de deteriorización de una sinusitis frontal, Rev. otorrinolaring. d. litoral **1**:459 (Aug.) 1942.

riod of four years, during which time it d the anterior wall without breaking the steum, causing a cystlike tumor in the mid- f the forehead. This gave rise to severe toms at times, which seemed to be relieved nasal discharge, and then remained quies- until another acute flare-up due to blocking e duct. The patient was eventually cured two external operations on the frontal sinus radical operation on the antrum.

unusual case of Paget's disease involving frontal sinuses is reported by Harris.[119] e were no lesions anywhere in the skeleton t those in the skull, which were demon- d in roentgenograms. The patient had a arging fistula in the midportion of the left r eyelid and swelling over both eyes. ratory tests showed an elevated concentra- of serum phosphatase (24 Bodanski units hundred cubic centimeters). Purulent llary sinusitis was relieved by intranasal stomy. The frontal sinuses were opened rally through an external incision, reveal- ystic degeneration and an erosion of the rior plate on one side. The nasofrontal could not be located, and the cavities were ed via the opened ethmoid sinuses. The was found to be spongy, thickened and ular, and much bleeding was encountered g the operation. Recovery was complete, closure of the fistula, disappearance of pia and absence of discharge.

hachter,[120] analyzing 81 cases of the Mor- i-Morel syndrome, notes that hypertension a prominent finding in 67 per cent of the s and concludes thereby that the disease is to overfunction of the anterior lobe of the physis. He argues that since hypertension und in 83 per cent of cases of Cushing's se and in 55 per cent of cases of acromegaly, being disorders of the pituitary body, the uency of hypertension in cases of frontal erostosis must be due to disease of the same n.

rollman and Rousseau[121] made a study of atients suffering from metabolic craniopathy. y believe that hyperostosis frontalis is a nite clinical entity, even though postmortem erial is not as ample as might be desired. y assume that the pathogenesis is in the hypothalamic area and that the endocrine theory is not supported by such pathologic material as has come to their notice. They find the disease more frequent than is generally conceded.

Pereira da Silva and Penha Godoy d'Alambert[122] have written an extensive article on hyperostosis frontalis interna, which includes a complete résumé of the literature, a discussion of the pathogenesis and the details of 14 cases observed by the authors. All the pertinent data of these cases are given in detail, including photographs and roentgenograms. The authors list obesity, headache, hypercalcemia and menstrual disturbances as the predominant symptoms. They insist that roentgenograms be taken in all cases, especially those in which the syndrome is not so pronounced.

Seven cases of the same condition are reported by Gonzalez Torres.[123] The patients were women between the ages of 30 and 50. They all manifested the usual endocrine symptoms and most of them obesity. One departed from the usual pattern by manifesting loss of weight and hyperthyroidism. Several roentgenograms are shown, which seemed to have lost their clarity in the printing.

Petit-Dutaillis, Messimy, Ribadeau-Dumas and Xambeu[124] tried frontal decompression in a man suffering from diffuse endocraniosis with marked psychic disturbances, a form of anxiety melancholia, with mutism, negativism and catalepsy. The decompression resulted in recession of the symptoms. After a free period of six years, recurrence of the symptoms led to a second operation, at which time a large area of bone (9 by 8 by 7 cm.) was removed. This section was as thick as 2 cm. in places, being irregular in contour on its posterior surface. The dura was thin and closely attached to the bone. A laceration of the dura exposed the frontal lobe, which appeared somewhat edematous, with numerous dilated and tortuous vessels in evidence. The postoperative period was characterized by signs of meningeal irritation and psychomotor symptoms, besides the anticipated local symptoms in the eye and the forehead.

9. Harris, H. E.: Paget's Disease of Skull Complicated by Mucocele of Frontal Sinuses, Cleveland Clin. Quart. **11**:74 (July) 1944.

0. Schachter, M.: L'hypertension artérielle au cours ndrome de Morgagni-Morel, Monatschr. f. Psychiat. eurol. **106**:237, 1942.

1. Grollman, A., and Rousseau, J. P.: Metabolic iopathy, J. A. M. A. **126**:213 (Sept. 23) 1944.

122. Pereira da Silva, C., and Penha Godoy d'Alambert, J.: Síndromo de hiperostóse frontal interna, Arq. assist. psicopat. estad. São Paulo **8**: 101 (March-June) 1943.

123. Gonzalez Torres, D. M.: Hiperostóse frontal interna ou síndrome de Morgagni, Arq. neuro-psiquiat., São Paulo **1**:285 (Dec.) 1943.

124. Petit-Dutaillis, D.; Messimy, R.; Ribadeau-Dumas, C., and Xambeu, C.: Endocraniose diffuse du crâne, avec hyperostose frontale interne, chez l'homme: Guérison des troubles psychiques après une double trépanation frontale, Rev. neurol. **74**:57 (Jan.-Feb.) 1942.

These, however, subsided within a few weeks, with great amelioration in the general condition.

Rebattu [125] reports 3 cases of tuberculosis involving the ethmoid sinuses in persons past the age of 50. The chief symptoms were nasal obstruction due to a mass which blocked the passages and caused external swelling. The diagnosis could be made only on biopsy, since the tumor clinically resembled a cancer. One of the patients succumbed in an early stage of postoperative bronchopneumonia. In the second patient a good primary result was obtained, but the patient left the clinic and could not be traced. In the third, an old pulmonary lesion lighted up and was active at the time the report was made. The author claims that the prognosis is better in cases in which there is no concurrent suppurative sinusitis. All 3 patients were operated on by lateral rhinotomy.

Wickstrom and Hebble [126] report that penicillin proved to be effective in curing fulminating ethmoiditis due to staphylococci, which had resisted sulfadiazine. The patient was a man of 20 with a history of a head cold of five days' duration. There occurred a sudden rise in temperature to 105 F., edema of the forehead, limitation of ocular movements and signs of extreme toxemia. Nasal and blood cultures revealed Staphylococcus aureus, and roentgenograms showed involvement of the ethmoid sinuses alone. Penicillin was given intravenously in doses of 20,000 units every three hours. Improvement was noted after twenty-four hours. It continued for a week, and then an orbital abscess was drained, which revealed the same bacteria as were found in the blood. Recovery was uneventful, with complete restoration of function. It is the opinion of the authors that more serious complications were averted by the administration of penicillin.

Van Alyea,[127] referring to Szanto's report (personal communication) that he had encountered sphenoid disease in 14 of a series of 100 consecutive autopsies, was able to corroborate this report in a study of 100 specimens picked at random from the anatomic laboratory. The factors which he believes operate in the production of sphenoid disease are listed under two headings, namely, anatomic and pathologic, embracing some ten items: The anatomic fac[tors] are naturally all those conditions which im[pede] proper ventilation and drainage. The pa[thologic] logic factors include allergy, thickened mu[cous membrane] and infection of the posterior ethmoid c[ells]. Van Alyea divides sphenoiditis into three clin[ical] types, namely, acute sinusitis, exacerbation [of] chronic infection and chronic empyema. Typ[ical] examples of each are cited. In diagnosis reli[ance] is placed on proper examination, roent[gen] studies with or without use of a contrast medi[um] and experimental irrigation.

Fractures; Trauma; Foreign Body.—Sch[orsch]stein [128] presents a thorough analysis of 8 c[ases] of compound fracture involving the orbit [and] the frontal and the ethmoid sinuses. Diagr[ams] showing the external laceration, the extent of [the] bony involvement and the surgical exposure [in] each case make the article clear and conc[ise]. In 6 of the cases early operative proced[ure] disclosed extensive comminution of the bo[ne] far beyond the lacerated area. In 5 of th[e] the frontal sinuses were broken, in 4 the ethm[oid] cells were involved and in 4 the orbit was [in]vaded. The dura was lacerated in all 6, [a] gross injury to the frontal lobe was obser[ved] in 4. The procedure followed was to operat[e] soon as the patient had recovered from [the] initial shock. The laceration was excised [and] extended sufficiently to expose the underly[ing] pathologic factors; loose fragments of bone w[ere] carefully removed. If the sinuses were open[ed] the mucosa was removed, although the aut[hor] is not convinced that this maneuver is necess[ary]. The roof of the orbit was exposed and the d[ura] inspected. If macerated brain pulp was expo[sed] through a dural tear, it was removed. The d[ura] was closed either by direct sutures or by a fas[cia] graft taken from the temporal muscle. If [the] dura was torn over the cribriform plate, it w[as] plugged with a muscle graft. A sulfonam[ide] compound in the form of powder was dus[ted] over the area, which was drained with cor[ru]gated rubber drains. The wound was closed [in] layers. Sulfonamide drugs were given p[ost]operatively. In several of the cases the exter[nal] deformity was subsequently corrected with [a] graft from the outer table of the skull or w[ith] a tibial graft.

Cases 7 and 8 are considered separately, si[nce] the patients were first seen some time after [the] injury. The patient in case 7 was admitted [two] days after the accident with symptoms of men[in]gitis, although the spinal fluid failed to re[veal] bacteria. He was operated on and recove[red]

125. Rebattu, J.: La tuberculose de l'ethmoïde à forme tumorale, J. de méd. de Lyon **23**:493 (Sept. 20) 1942.

126. Wickstrom, O. W., and Hebble, H. M.: Acute Suppurative Ethmoiditis with Orbital Abscess and Septicemia Treated with Penicillin, U. S. Nav. M. Bull. **42**:1379 (June) 1944.

127. Van Alyea, O. E.: Sphenoid Sinus Drainage, Ann. Otol., Rhin. & Laryng. **53**:493 (Sept.) 1944.

128. Schorstein, J.: Compound Fronto-Orbital Fr[actures], Brit. J. Surg. **31**:221 (Jan.) 1944.

a stormy convalescence complicated by phalitis, meningitis, sciatic neuritis and smia.

The patient in case 8, with a compound frac- involving the frontal sinuses and the roof the orbit, was seen five months after the dent. The history given was that, following injury, the wound was sutured without hav- been explored. Despite meningeal symp- s, the patient recovered. At this time exami- on revealed extensive fractures involving the t and the frontal sinus. The patient was with a residual facial palsy, deafness in one and (curiously) sciatic neuritis.

According to Escher,[129] war wounds of the are frequently associated with fracture of sinuses and are often followed by suppura- unless adequate drainage is afforded. en the frontal sinus is involved, the posterior l should be inspected, and if it is fractured, ugh bone must be removed to permit inspec- of the dura. If the ethmoid sinuses are matized, the area should be exposed through incision near the external angle of the orbit. en the maxillary sinus is affected, it should pened sublabially and adequate drainage pro- ed through the nasoantral wall. If the orbit affected, drainage may be effected via the ely opened antrum by removal of a portion the floor of the orbit.

Fenton[130] calls attention to the possibility of ve consequences of trauma to the frontal a if the heavy superciliary ridges have given . The danger of osteomyelitis or intracranial plications is greatly enhanced by preexisting usitis. It is important in all cases of trauma his area, especially of trauma which appears erficial, that the patient be watched care- y for the persistence of such symptoms as dache and local swelling. A patient with h symptoms must be critically examined and rgetically treated to prevent the extension of ecrudescent infection which has been lighted by the trauma. Several illustrative cases are d and suggestions offered as to the manage- nt.

Johnson[131] describes the use of a water- anded rubber balloon which is inserted in antrum for the support of the fragments of a comminuted fracture of the malar bone. The patient was operated on about two weeks after the accident by the Caldwell-Luc procedure, which revealed a badly infected antrum. This was cleaned out and the customary opening made into the nose by way of the inferior meatus. The bony fragments of the floor of the orbit were held in place by a rubber balloon filled with water. The tubular end of the balloon was brought into the nose and the sublabial incision closed. It was necessary on two or three occasions to vary the amount of water in the balloon to secure more accurate adjustment of the fragments. The balloon was removed after three weeks.

Gurdjian and Webster[132] present an analysis of 31 cases of depressed fractures extending through the frontal sinus, the cribriform plate and the orbit, with special emphasis on the evaluation of rhinorrhea and pneumocephalus in relation to the surgical indications. Their record of 28 recoveries and only 3 deaths speaks well for the care with which these cases were studied and for the therapy employed.

In the absence of cerebrospinal rhinorrhea or pneumocephalus they advise treating fractures in this region conservatively, i. e., by débridement and simple repair. Compound depressed fractures must be exposed, since they are so frequently associated with dural tears. In such cases the authors recommend an exposure by extension of the original laceration.

Cerebrospinal rhinorrhea is an indication for surgical exposure, since it is usually the result of dural laceration and comminuted depressed fracture. Pneumocephalus without rhinorrhea or evidence of comminution may be treated conservatively, although it is necessary to follow up with frequent roentgen examinations; increase in the amount of air is usually an unfavorable sign and suggests the necessity of prompt exposure.

When associated with rhinorrhea, pneumocephalus may be a symptom of grave portent, and the indication is for prompt and adequate exposure.

Dural lacerations may be repaired directly with sutures or, if necessary, with fascia lata or, as illustrated in one of their cases, with a flap from the adjacent falx. At times the dura is held away from the bone by a pack left in situ for several days as a means of preventing the formation of a fistulous tract into the sinus.

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129. Escher, F.: Surgical Treatment of War Injuries the Nasal Accessory Sinuses, Schweiz. med. Wchn- . **73**:715 (May 29) 1943; abstracted, Bull. War Med. 78 (Jan.) 1944.

130. Fenton, R. A.: Traumatism of the Frontal uses, Arch. Otolaryng. **40**:157 (Sept.) 1944.

131. Johnson, M. R.: Depressed Fracture of the bital Rim, S. Clin. North America **24**:340 (April) 4.

132. Gurdjian, E. S., and Webster, J. E.: Surgical Management of Compound Depressed Fracture of Frontal Sinus, Cerebrospinal Rhinorrhea and Pneumocephalus, Arch. Otolaryng. **39**:287 (April) 1944.

The paper is well illustrated and adds much to present knowledge of the surgical treatment of traumas incurred in the region of the sinuses.

Scharfe [133] describes an ingenious and simple method of supporting the fragments in a fracture involving the maxillary sinus and the floor of the orbit. The approach is through the usual Caldwell-Luc incision. After clots have been cleaned out of the sinus and a counteropening has been made into the inferior meatus of the nose, the orbital rim is raised into position and fixed by means of a stanchion fashioned out of no. 18 gage stainless steel wire. The wire is twisted, leaving both ends Y shaped. "A drop of solder may be put in the center of this, to hold it solid and prevent unraveling." It is cut to such a length as to permit one end to support the depressed orbital fragment while the other end is braced on a "small V-shaped depression made in the bone of the anterior wall just above the alveolus." After three weeks the sublabial incision is opened and the wire splint removed. Roentgenograms made after placing the splint and subsequent to its removal will assist in checking the accuracy of the replacement.

Luque and Coronel [134] describe in detail the clinical course of a trauma to the frontal area caused by a flying piece of metal, which inflicted a crushing injury. It resulted in a deeply depressed comminuted fracture of the left frontal bone with laceration of the dura and trauma of the frontal lobe. After recovering consciousness and following the operation, the patient manifested a series of neurologic symptoms indicating impairment of function of the frontal lobe, such as loss of memory, difficulty in orientation and changes in personality. Roentgenograms disclosed a subdural pneumatocele. The authors devote considerable space to a discussion of the diagnosis of lesions of the frontal lobe, citing a number of articles in the literature. They are not convinced of the existence of a definite syndrome characteristic of pneumocephalus, although they point out that both ventriculograms and roentgenograms permit adequate visualization and localization of the lesion.

McKenzie [135] reports 10 cases of skull fracture involving the frontal and ethmoid sinuses in which there was evidence of dural lacerati Rhinorrhea varied from a slight amount las only two or three days to a profuse discha which did not appear until the forty-sixth Roentgenograms were of great value in loca the lesion. The author is emphatic in advis extensive surgical exposure with repair of dural laceration by sutures, a fascial g or temporal muscle. He states that the cor incision with the soft tissues reflected downw to the supraorbital ridges affords the best proach. An osteoplastic flap is turned up, hin on the temporal muscle; it may be bilatera necessary. The dura is stripped away from orbital roof and the cribriform area (diffi and tedious), and in some cases the crista g is removed so as to afford a smoother sur should a fascial graft be required in this a A sulfonamide compound is used liberally in form of powder and is also given internally adequate doses. The author is against tempo ing in any case in which rhinorrhea is dem strated, because of the danger of delayed or s sequent meningitis.

Thornell and Williams [136] report a case wh illustrates the importance of investigating draining fistula, particularly when there i history of a foreign body. In this case, a c of 3 fell on a branch, which penetrated the lo eyelid and was supposedly removed at the ti However, a fistula persisted, and although ro genograms failed to reveal a foreign body, area was exposed by an incision parallel to floor of the orbit, which revealed a large por of a twig embedded in it and penetrating i the antrum and the ethmoid sinus. Also, th was extensive sequestration of the roof of antrum with secondary infection.

Ameriso [137] reports an interesting case which a man attempted suicide by shooti himself in the right parietal region. The bu traversed the orbit, lodging in the middle th of the internal wall and supraorbital reg At that time several fragments of the metal w surgically removed, along with the bulb. T years later he entered the clinic, complaining severe pains in the fronto-orbital region the maxilla. Examination revealed an ov swelling at the superointernal angle of the o about 3 by 3.4 cm. in size, which was cove with normal skin and was dense in consiste and adherent. Roentgenograms showed mar

133. Scharfe, E. E.: A Method of Fixation in Fractures Involving the Maxillary Antrum, Canad. M. A. J. **50**:435 (May) 1944.

134. Luque, O., and Coronel, J.: Lesión traumática pre-frontal y neumo-encéfalo, Rev. argent.-norteam. cien. méd. **1**:546 (Sept.-Oct.) 1943.

135. McKenzie, D.: Head Injuries Involving Air Sinuses, Brit. M. J. **1**:652 (May 13) 1944.

136. Thornell, W. C., and Williams, H. L.: For Body Involving the Floor of the Orbit and the Antr Arch. Otolaryng. **39**:83 (Jan.) 1944.

137. Ameriso, J.: Piocele de seno frontal y muco de antro de Highmoro, por traumatismo, Rev. otorr laring. d. litoral **2**:87 (Dec.) 1942.

ding of the right frontal sinus and orbit, loss ubstance of the inner third of the supra- ry arch and a metal-like opacity about 1 by m. in the superointernal angle of the sinus. e were evidences of numerous smaller frag- ts. A combined Killian and Ermiro de Lima ation was performed, exposing the frontal oid cells and the antrum. The larger missile found embedded in bone, a portion of which to be resected for its complete removal. A ele was observed in the frontal sinus and ucocele in the antrum. The author considers combination of circumstances extremely ual and, as it was due to the trauma, he idered it worth reporting.

MISCELLANEOUS CONTRIBUTIONS

remble[138] believes that few headaches are to nasal conditions, although there is a spread tendency of the laity and a large ber of physicians to ascribe most headaches athologic conditions in the nose and acces- sinuses. The author then describes a num- of typical sinal conditions, such as the uum headache" and headache due to acute sitis, chronic sinusitis with polyps or en- ement of the middle turbinate, giving the l well known diagnostic signs. He describes neurologic type formerly known as "Sluder's rome" and directs attention to Vail's work onnection with pains due to sphenoiditis. hasis is laid on the necessity for thorough mination in each case and the importance of a nasopharyngoscope as well as contrast ums in connection with roentgen studies. rom Green's Eye Hospital[139] comes a sug- ion that relief from atypical headaches can btained by cocainization of the trigger zones in the nose. A 5 or 10 per cent solution ocaine hydrochloride is instilled into each of the nose (5 to 10 drops on each side) the head in the Proetz displacement posi- Mention is made of topical application hich the anesthetic solution is applied di- y to the region of the nasociliary nerve or ie sphenoethmoid recess.

ampbell[140] states that aerosinusitis is a clin- entity similar to the aero-otitis observed ng aviators. It is due to sudden changes in pressure incident to rapid ascent and descent great heights. It usually results from the latter and is caused by the trapping of rarefied air within the sinuses by swelling of the mucosa about the ostium. The symptoms are severe pain over the affected sinus (usually the frontal or the maxillary). A roentgenogram reveals clouding, thickened lining and frequently a localized mass caused by stripping of the mucosa and submucous hemorrhage. Several striking examples are presented by the author. Treatment of obstructive types is discussed. If stripping of the mucosa or a hematoma has developed, surgical treatment may be required. In other cases, relieving the obstruction at the ostium and returning the subject to the altitude at which the block occurred (which can be done in a pressure chamber), local application of heat and other likely measures may prove helpful in relieving the symptoms.

Gibbs[141] suggests the practicability of using the mask as a means of equalizing air pressure within the tympanic cavity and the sinuses when obstruction is due to descent from a high altitude. The procedure as he describes it is as follows:

1. Don mask. (Canister can be removed.)
2. Adjust facepiece.
3. Suddenly and firmly close inlet tube and exhale—to clear mask of any residual air.
4. Inhale as deeply as possible and hold breath for a few seconds.
5. Repeat.

This procedure is capable of effecting a change in air pressure up to 2 pounds per square inch (140 Gm. per square centimeter), positive or negative; thus a range of 4 pounds is equivalent to about 8,000 feet (2,438 meters) change in altitude.

Bernfeld[142] discusses nasal and sinal allergy in relation to chronic cough of nonbacterial origin and the value of local anesthesia as a means of giving the patient relief and, frequently, cure. He cites several authorities to show that locally induced ischemia will block the chain of anaphylactic symptoms and frequently lead to cure by giving the tissues time to eliminate the offending allergens and produce effective antibodies. The procedure recommended is that of anesthetizing the nasal mucosa with a 2 per cent tetracaine hydrochloride solution containing epinephrine hydrochloride 1:1,000 and then making a submucous and subperiosteal injection

8. Tremble, G. E.: Headache of Nasal Origin, d. M. A. J. **50**:43 (Jan.) 1944.

9. Headaches of Nasal Origin (So-Called Atypical alalgias), Bull. Pract. Ophth. **14**:14 (May) 1944.

0. Campbell, P. A.: Aerosinusitis: Its Cause, se, and Treatment, Ann. Otol., Rhin. & Laryng. 91 (June) 1944.

141. Gibbs, O. S.: The Use of a Gas Mask for the Relief of Occluded Eustachian Tubes and Sinuses, J. Aviation Med. **15**:32 (Feb.) 1944.

142. Bernfeld, K.: Sinusonasal Anesthesia: A Method of Treating Irritative Cough of Nasal Origin and Allergic Rhinosinusopathia, Acta med. orient. **3**:13 (Jan.-Feb.) 1944.

of a 1 per cent procaine hydrochloride solution with 12 to 15 drops of epinephrine hydrochloride in the locations usually employed for a Caldwell-Luc operation. The effects of this therapy were amazing in several cases cited by the author, in which the edema of the antral mucosa, the polypoid swellings in the sinuses and the enlargement of the turbinates all disappeared and the roentgenograms revealed clearing of the antrums. In most cases the author recommends repeating the injections two to four times, since a single injection will seldom suffice.

Horgan [143] states that postnasal drainage due to chronic disease affecting the ethmoid sinuses in most instances. He believes that a diagnosis can be made by postnasal mirror examination and roentgen study. In addition to displacement therapy he recommends, on the one hand, cutting down the use of meat, sugar and condiments and, on the other, surgical intervention, such as removal of polyps and hyperplastic portions of the turbinates.

143. Horgan, J. B.: The Causes and Treatment of Postnasal Catarrh, M. Press **212**:319 (Nov. 15)

Abstracts from Current Literature

Ear

ritical Review of the Fenestration Operation: Report of Cases. Charles E. Kinney, Laryngoscope **55**:117 (March) 1945.

here is confusion in the literature as to the indicaons for the fenestration operation. Kinney enumerates rly the points to be considered in making a diags of progressive stapedial impediment. A contraation to the operation is a bone conduction curve wing a greater loss of hearing in the higher frecies than in the lower frequencies. Operations on atients with such curves gave no hearing improvet. He states, "Improvement in our methods of ring testing, particularly in bone conduction testing, enable us more adequately to select the cases for procedure."

inney prefers the Lempert method of inducing anesia (a combination of analgesia and local anesthesia). also uses the Lempert surgical approach (the ural approach) and gives reasons why he prefers . He discusses the technic of operation and the perative complications.

erious complications, such as permanent paralysis he eighth (auditory) nerve, totally dead labyrinth ersistent vertigo, enter into not more than 2 per of the cases in which the operation is performed. o one has determined exactly why some of the stras close and others remain open. If a fenestra ains open for from six to eight months, it will ably stay open, although again this is not definite. evaluating the results of the operation, Kinney ks that one should use the American Medical ociation percentage determination method. He ifies his results in 8 cases as excellent, good or r and explains just what is meant by each classifica-. He had 50 per cent excellent results.

Hitschler, Philadelphia.

pture of a Left Temporosphenoidal Brain Abscess into the Ventricle. Louis E. Wolfson, New England J. Med. **230**:170 (Feb. 10) 1944.

Wolfson reports the case of a 56 year old man who chronic infection of the left mastoid process for -one years. After an acute infection of the upper iratory tract, an exacerbation of the mastoiditis eloped, and a radical mastoidectomy was performed hat side. Sulfadiazine was given. Cultures of pus n the mastoid area revealed Staphylococcus albus a nonhemolytic type of Streptococcus.

ive days after operation right hemiparesis and stupor eloped. The wound of the mastoidectomy was relored, and the underlying dura was found to be e. The dura was incised, as was the brain, and annula was inserted for a distance of 3 cm. and pus ained (Staph. aureus, diphtheroids and a nonhemoc type of Streptococcus). Clinical recovery was mpt. The level of sulfadiazine in the blood was ntained at about 10 mg. per hundred cubic centiers.

Subsequently, iodized poppyseed oil was injected into the cavity of the abscess, and roentgenograms indicated that the cavity communicated with the left lateral ventricle.

Wolfson states that the sulfadazine in high concentration probably checked further spread of the infection. Rupture of such an abscess is extremely rare and is generally seen only at autopsy. Roentgenograms showing such an event during life have not heretofore been reported.

Guttman, Philadelphia.
[Arch. Neurol. & Psychiat.]

Wounds in the Ear and Mastoid Region. R. Whittaker, J. Laryng. & Otol. **59**:205 (June) 1944.

A series of 29 military casualties sustaining mastoid wounds is presented. The casualties were divided into (1) those with no injury to the mastoid bone, (2) those with injury but no infection of the mastoid bone and (3) those with injury and infection of the mastoid bone. There were 9 patients in the first group, 10 in the second and 10 in the third.

The author found that infection did not spread so rapidly from the middle ear to the mastoid cells as he had once supposed. Consequently, a later, more satisfactory treatment of such casualties was confined to removal of loose bone, without drainage of the mastoid cells or the mastoid antrum. If spread of infection from the middle ear to the mastoid cells occurred, it was treated later by mastoidectomy. The use of sulfathiazole, sulfadiazine or penicillin and infrequent local dressings were adjuncts to simple débridement. Casualties treated early by excision, insufflation of penicillin and suture frequently experienced primary healing. In casualties with loss of skin or damage of the external auditory meatus, débridement followed by delayed suture or healing by granulation was successful. The drum membrane was commonly perforated by blast or local explosive effect of missiles on the tissues, and infection of the middle ear was almost always present. The author believes that bandages applied to the ear, blood and dirt entering the meatus at the time of the injury, and drops or powders inserted in the meatus definitely favor the development of infection of the middle ear. Consequently, he feels that simply inserting a piece of sterile cotton wool loosely in the meatus after injury is more advisable.

LeJeune and Steele, New Orleans.

Pharynx

Abscesses of the Pyriform Sinus. Anthony Nigro, Laryngoscope **55**:228 (May) 1945.

Fourteen cases of abscess of the piriform sinus have been reported since 1934. The abscess results by direct continuity from infection of surrounding areas or of the blood stream. The symptoms are pain, hoarseness and dyspnea. Spontaneous rupture may occur. The prognosis is generally favorable. Treatment consists of chemotherapy, general supportive measures and local

procedures. A tracheotomy set should be on hand. Nigro had 1 patient whose abscess required external drainage.

HITSCHLER, Philadelphia.

THE USE OF BISMUTH IN THE TREATMENT OF VINCENT'S INFECTION. HUGH M. COX AND JOSEPH H. HODAS, New York State J. Med. **45**: 741 (April 1) 1945.

Thirty-five patients were treated with bismuth compound for Vincent's infection. In only 2 of them did the condition fail to respond. The signs and symptoms were malaise, a temperature of 100 to 101 F., general pains, pain in the throat, tender glands on the affected side and offensive breath. Unilateral involvement was the rule. On the tonsils there was a yellowish membrane which broke away in a day or two, exposing the underlying ulcer. There is also a nonulcerative form, with vesicles. The diagnosis was confirmed by laboratory studies. After a smear showing Vincent's infection was obtained, 2 cc. of Sobisminol solution was injected into the buttocks. This preparation is obtained by dissolving the products of the interaction of sodium bismuthate, triisopropanolamine and propylene glycol in a mixture of propylene glycol and water. The throat was reexamined four or five days later, and if a smear showed the organisms, another injection of the bismuth preparation was given. Likewise a third was administered, if necessary, and a fourth about one week after that. Pain and general relief were obtained within thirty hours, and smears were usually negative by the tenth day. The authors call attention to the possible presence of sinusitis, bronchiectasis or abscess of the lung having origin in Vincent's infection and caution one to "search diligently" for the organisms. "Recurrences appear much less frequently with this type of therapy than with local therapy." No toxic results were observed. The authors regard intramuscular use of bismuth compound in cases of Vincent's infection as "inexpensive, accessible and safe."

VOORHEES, New York.

DIAGNOSIS OF TUMORS OF THE NASOPHARYNX. J. M. PORDES, Acta oto-laryng. orient. **1**:1, 1945.

Pordes discusses the symptom complex of nasopharyngeal tumors and places emphasis on the so-called syndrome of Trotters. This includes secretory catarrh of the ear, headache on the affected side and occasionally trismus due to spasmodic contraction of the internal pterygoid muscle. Nasal obstruction, usually unilateral, is more or less common to patients with benign growths. On the other hand, patients with malignant tumors usually exhibit their own characteristic symptoms, such as recurrent attacks of hemorrhage, frequently obscure in origin, eustachian obstruction, tinnitus and, as a late development, cervical adenopathy. Roentgen examination usually substantiates the evidence from both posterior rhinoscopy and nasal pharyngoscopy. Pordes reports 2 cases—the first an instance of squamous cell epithelioma of the nasopharynx with extension to the vertebral column, and the second an instance of lymphadenoma of the nasopharynx. He stresses the value of biopsy and microscopic examination. He doubts the value of irradiation of these tumors. (While resort to surgery is definitely indicated in the benign fibroma, the cancers, such as lymphoepithelioma and some of the small cell epitheliomas, are extremely radiosens and regression of these with high voltage roen therapy or even radium therapy is not uncommon.)

PERSKY, Philadelph

Nose

THE RECOGNITION AND PALLIATIVE TREATMENT EARLY SINUS TROUBLE IN CHILDREN. H. G. FORD RUSSELL, Proc. Roy. Soc. Med. **36**:401 (J 1944.

Sinus trouble is common in children, in whom exanthems pave the way for streptococcic infec Tissue response to streptococci is production of ed not pus. Insistence on the presence of pus for diagnosis of sinusitis has occasioned nonrecognitio numerous cases in which irritation of the fifth (trig inus) nerve and local absorption along the lymph produce symptoms (e. g., "neuralgia") customarily garded as primary in parts remote from the sin Tonsillar inflammation, otitis media, conjunctivitis headache are usually the result of sinusitis. The cogent result of acute inflammation of the linings of sinuses and of the nasal passages is the mecha difficulty occasioned at the ostiums by swellings of membrane in an inexpansible bony ring, which lead "sinus block." The indication, therefore, is to re the edema at the ostiums so as to permit normal e of air into the sinuses and to facilitate escape of increased secretion. This can be achieved by the in duction of nontoxic, volatile vasoconstrictors, such desoxyephedrine or amphetamine sulfate.

The principle of the displacement method is descri

Iodized poppyseed oil is valuable in roentgenol diagnosis.

WILLIAMSON, New Orleans. [AM. J. DIS. CHIL

THE DIAGNOSIS AND TREATMENT OF SINUSITIS CHILDREN. S. E. BIRDSALL, Proc. Roy. Soc. **36**:403 (June) 1944.

In 1939 the author recorded the clinical feature 80 cases of indisputable sinusitis. The cases selected because the diagnosis had been proved be all doubt. It is rare that sinusitis of children is discernible by the ordinary methods of examin if these are properly performed. In only 13 of th cases was there good evidence of an antecedent c Of the specific disease factors, whooping cough undoubtedly the commonest.

The symptoms of sinusitis are often ascribed to i tion of the tonsils and adenoids.

In the series of 80 cases the most common sympt in order of frequency, were: (*a*) nasal obstruction, cough, (*c*) colds, (*d*) anorexia and (*e*) otorrhea.

The diagnosis was made by examination.

In conclusion, the author discusses his method treatment.

WILLIAMSON, New Orleans. [AM. J. DIS. CHIL

MUCOCELE OF THE FRONTAL SINUS. N. SADOW Acta oto-laryng. orient. **1**:21, 1945.

Sadowsky describes a large mucocele involving right frontal sinus. He performed a radical opera and removed the mucocele in toto. The patient m an uneventful recovery.

PERSKY, Philadelphi

Miscellaneous

ERNOUS-SINUS THROMBOPHLEBITIS — REPORT OF A ASE WITH MULTIPLE CEREBRAL INFARCTS AND ECROSIS OF THE PITUITARY BODY. AVERY D. WEIS-AN, New England J. Med. **231**:118 (July 27) 1944.

eisman reports the case of a 13 year old boy in m thrombophlebitis of the cavernous sinus developed equent to a furuncle on the nose. During the course e illness, a total of twenty-four days, the patient ited edema about the left eye with proptosis. He comatose much of the time. When aroused, he rstood simple commands but was unable to speak. e was right hemiplegia with overactive deep tendon exes and an equivocal Babinski sign. Also, right nonymous hemianopsia was present, and funduscopic ination revealed edema and hyperemia, with blur- of the nasal margins of the disks. There was no onse to painful stimuli over the right side of the The patient had one generalized seizure. The brospinal fluid was under increased pressure and yellowish and cloudy, and the white cell count 2,900 leukocytes, of which 1,450 were polymorpho- ear leukocytes and 750 were erythrocytes. The protein measured 534 mg., the sugar 57 mg. and chlorides 639 mg. per hundred cubic centimeters. phylococcus aureus, hemolytic type, was grown from spinal fluid, as well as from the blood. Sulfadiazine of little avail, and trephination on the left side d to reveal evidence of a subdural abscess. The nt died twenty-four days after the onset of his ss.

e significant findings at necropsy were as follows: mbophlebitis of the left and right cavernous sinuses, left superior petrosal sinus and the ophthalmic ; bilateral orbital abscesses; basilar purulent lepto- ingitis; infarction of the pituitary gland; small, nt infarcts involving the left frontal, parietal and cto-occipital cerebral lobes; cerebellar pressure ; internal hydrocephalus; fibrinopurulent pleuritis empyema (right).

lthough several thrombosed arteries were found, no ce of the thrombosis could be ascertained. The ologic observations provide an explanation of the al picture. The possibility of hypopituitarism as quel of thrombophlebitis of the cavernous sinus is ested.

GUTTMAN, Philadelphia.
[ARCH. NEUROL. & PSYCHIAT.]

SPEECH HANDICAPPED. WENDELL JOHNSON, Rev. Educ. Research **14**:241 (June) 1944.

hnson finds that the estimates of the number of ren with defective speech in the public schools in United States vary according to the definitions the methods of survey used and that there are e boys than girls with defective speech. He finds children with defective speech present all levels telligence but that more of them show a subnormal . According to the studies made before 1941, ren whose speech was defective were more retarded lastically than their intelligence levels warranted, since 1941 investigators have found that there is no such retardation. Although correction of speech in the United States has been developed through the public schools, only a small percentage of the needy ones are given treatment. The author states that many textbooks and articles on correction of speech have been published recently. There has been increased research in the field of disorders of speech, especially in that of the development of speech and language, of the interrelation of speech and hearing, and of language behavior. The field of the pathology of speech has been extended in the past few years by research, and a number of authors and investigators are mentioned. The article is well documented and annotated

FERGEN, University, La.

DO YOU KNOW SOMEONE WHO STUTTERS? JAMES F. BENDER, Scient. Monthly **49**:221, 1944.

Bender gives a general review of the history and the incidence of stuttering and of the relationships of sex, intelligence and handedness to stuttering. Three case histories are given as illustrations of three different corrective technics used to meet the special problems of these cases. One method, concerned with stuttering due to an environmental difficulty, was informal and indirect. The other two were direct, with relearning taking place by voluntary stuttering in one case and by phonetic analysis practiced by the patient in the other.

POLLACK, Evanston, Ill.

MEDIASTINAL EMPHYSEMA. R. L. FLETT, J. Laryng. & Otol. **59**:235 (July) 1944.

In the case reported, mediastinal emphysema developed twenty-four hours after removal of the tonsils and adenoids, which was followed by reactionary nasopharyngeal bleeding. Subsequent bronchoscopy revealed a check valve obstruction of the right main bronchus due to a blood clot. This was removed by suction, with immediate improvement in regard to cyanosis and dyspnea. The rather high temperature gradually receded over five days, as did the surgical emphysema, which at one time had appeared in the base of the neck, in the angles of the jaw, over the upper part of the chest and in the axillas. Roentgenograms of the chest made prior to bronchoscopy had shown air in the mediastinum and the neck with cardiac displacement to the left. On the fifteenth day after bronchoscopy roentgen examination revealed a return to normal. The patient was discharged from the hospital on the twenty-fourth day after operation.

An excellent study of mediastinal emphysema from the point of view of pathology, as well as a review of cases reported by others, is included. In the case reported it was decided that there had been ballooning of the right lung due to the valvular obstruction of the right main bronchus, which resulted in alveolar rupture and spread of air through the interstitial tissue of the lung to the hilus and the mediastinum. The author concludes that postoperative aspiration of blood from the nasopharynx may be considered as a possible common cause for abscess of the lung following adenotonsillectomy.

LEJEUNE AND STEELE, New Orleans.

Society Transactions

CHICAGO LARYNGOLOGICAL AND OTOLOGICAL SOCIETY

ELMER W. HAGENS, M.D., *President*

WALTER H. THEOBALD, M.D., *Secretary*

Regular Monthly Meeting, March 5, 1945

Visualization of Otitic Abscess of the Brain. Presented by DR. EDWIN J. BLONDER.

Visualization of a chronic otitic abscess of the brain by use of a substance roentgenologically opaque may be extremely valuable in determining the extent of the abscess and may be instructive in revealing the progress of such a lesion under management. Iodized poppyseed oil 40 per cent was instilled in a chronic temporosphenoidal abscess cavity with excellent results.

The patient was a man aged 37 who had suffered from bilateral chronic suppurative otitis media for at least twenty-five years; he had become totally deaf. Peripheral paralysis of the right side of the face came on suddenly five years prior to his entering the Illinois Eye and Ear Infirmary. The facial paralysis was unimproved. The patient complained of severe temporal headache on the right side, not improved by medication. The external canal of the right ear was dry. Most of the drum membrane was destroyed. The promontory was covered with scar tissue and a small moist granulation. The external canal of the left ear was moist. The drum membrane was destroyed, and moist granulations and scar tissue covered the promontory. The general physical and neurologic examinations gave otherwise negative results. The visual fields and the fundi were normal. No nystagmus was observed. The caloric test elicited a normal response with each ear. Laboratory tests, including the Wassermann test and spinal puncture, gave results within normal limits. The roentgenologist reported that the evidence "is suggestive of an inflammatory change in both mastoids, with pronounced reactionary bone sclerosis and possible cholesteatoma on the left side; there is a pronounced degree of low grade destruction of bone throughout."

On the basis of the history given radical mastoidectomy was performed on the right side. Soft necrotic material was present about the antrum, while the remainder of the mastoid process was largely sclerotic. As the attic was cleared of granulations, it became evident that the tegmen was necrotic, and as more necrotic bone and tissue were removed a sudden gush of brown liquefied pus exuded. Gauze was inserted in the abscess opening so that pus would not be evacuated too rapidly, to reduce the danger of secondary edema of the brain tissue. The wound was packed open, and sulfathiazole therapy was instituted. The contents of the abscess were found sterile on culture.

One week later the wound was reopened without anesthesia. The gauze pack was removed, and some pus was evacuated. A soft probe inserted in the abscess revealed that the cavity was large, with a firm capsule. About three-fourths ounce (22 cc.) of iodized oil was instilled into the abscess cavity by means of a syringe and a eustachian catheter. This was done with the patient on a cart in the operating room, and the patient was taken immediately to the roentgenologist for the making of plates. Two views were t lateral and an anteroposterior. The results wer tiful, showing the cavity of the abscess well fille iodized oil was completely evacuated in one w large soft rubber tube was inserted in the immediately after the taking of the first series o and subsequent roentgenograms were taken at intervals with the tube in place.

The patient's headache was relieved immediate the operation and has not returned to date (tw later). The subsequent course was uneventful, was discharged forty-four days after operatio March 1, 1945 a complete examination showed t to be dry, with no neurologic or ophthalmologi ings except for the peripheral facial paralysis an ness. He is a good lip reader and is able to wor day.

Carcinoma of the Sphenoid Sinus. Presen DR. CARL CHRISTOPH.

Carcinoma of the sphenoid sinus is a relative condition. According to Salinger, only 40 ma growths of the sphenoid sinus have been repo the literature up to 1939. However, carcinoma type is usually diagnosed so late that it is diffi determine exactly where the neoplasm arose.

This patient, V. D., a man aged 32, was see on March 8, 1943, with a hemorrhage from th side of the nose, which had lasted for two m He complained of severe headaches localized vertex and diplopia which increased on looking right.

Examination showed the septum deviated to the with a spur on the left side; the tonsils were Vision was: right eye, 20/25; left eye, 20/20. Pa of the right external rectus muscle was observed right visual field showed a triangular defect upper temporal quadrant; the left field was n Postnasal examination showed a tumor mass gr out of the right sphenoid sinus, and the roentgeno showed that the entire right sphenoid sinus was by the mass.

Examination of the blood showed a hemoglobi tent of 60 per cent, a red blood cell count of 3,3 a color index of 0.9 and a normal white cell The report on a frozen section taken from the mass showed it to be a carcinoma. The sinus cleaned out as thoroughly as possible, since there a rather severe hemorrhage. Four radium needles inserted, 10 mg. each, for ten hours, and on the fo ing day high voltage roentgen therapy was insti

Ten treatments of 250 roentgens were given to right and left sides, with the skin distance 70 cm field 10 by 15 cm., the voltage 800,000 kilovolts the milliamperes 10, filtered through lead 1.0, tin copper 3.62 and aluminum 3.0 mm.

Following the course of roentgen therapy, inje of an iron and arsenic preparation were given, after twelve of these injections the hemoglobin ro 90 per cent and the red cell count to 4,400,000.

The final microscopic diagnosis indicated a moder rapidly growing, poorly differentiated squamous carcinoma (grade III) invading vascularized fi tissue, as well as multiple polyps, glandular and fi and chronic inflammation.

atient's headaches disappeared after the fourth roentgen treatment. The diplopia was not quite rent, although still present when he looked to eme right. The patient has been under observa- two years since operation, and there has been nce of recurrence.

DISCUSSION

ALFRED LEWY: I wonder if Dr. Christoph would more detailed description of the appearance of ss when seen with the nasal mirror and the ryngoscope.

SAMUEL SALINGER: The mass described by Dr. h seemed to be fairly well isolated. I should sk from what portion of the sphenoid sinus it oved, and whether the entire sinus had to be ted; also, whether the growth was palpable. minded of a case that did not have so fortunate nation as Dr. Christoph's. The patient was a suffering from intractable headaches, who re- complete ophthalmoplegia and proptosis when I w her. I suspected a lesion of the brain and it, and on nasal examination I obtained a little on palpating the superior meatus with a probe. e idea of making a biopsy, I eventually cleaned enormous amount of tissue from the posterior cells and the sphenoid sinus and came up a blank wall which proved to be the posterior the sphenoid sinus. She received a large amount tion, which yielded an excellent primary result ed to cure her since the lesion had already in- he orbit and crossed the chiasm. A study of e of case reveals the fact that a malignant riginating within the sphenoid cavity can grow de the walls before there are any marked or ristic symptoms. Dr. Christoph's case is inter- ecause the cancer originated in a location where ad produced bleeding which led to examination gnosis.

GEORGE WOODRUFF: I should like to ask about jective symptoms of pain and headache.

CARL H. CHRISTOPH: In reply to Dr. Lewy, on al examination there was seen a bleeding mass me from the sphenoid sinus and extended into opharynx. It was impossible to tell whether terior wall of the sphenoid sinus had been because of the excessive bleeding. The anterior d already been destroyed by the tumor. The nograms showed the entire sphenoid sinus to d with a tumor mass.

r as symptoms were concerned the patient had, ion to headaches, diplopia, bleeding and difficulty thing.

t fifteen years ago I reported a case of osteoma sphenoid sinus before this society; this patient ntical symptoms. The only differential point in e would be a tumor of Rathke's pouch. How- do not believe that this tumor originated there.

oral Lobe Syndrome Following Mastoidec- y. Presented by DR. ALFRED LEWY.

, a Negro boy aged 12, was seen at the Illinois d Ear Infirmary on Sept. 12, 1940, complaining scharging ear which he had had since the age His mother thought that the condition followed ck of scarlet fever. The boy, who was in the grade in school, appeared dull, undernourished emic.

On examination the right drum membrane appeared normal; in the left ear, the membrane was absent, a polypoid mass was seen in the canal and there was a profuse foul discharge. The nose revealed a profuse mucopurulent discharge. The teeth were excellent; the mucosa of the mouth was pale. The tonsils were enlarged and infected; a large amount of adenoid tissue was present and profuse postnasal discharge. A diagnosis of chronic suppurative otitis media was made, with chronic sinusitis and hypertrophy of the tonsils and adenoids. The roentgen examination confirmed the findings in regard to the left ear; there was no normal cell structure; there was moderately dense sclerosis in the triangle, with mottled irregular density in the upper posterior region extending to the knee and over the sinus wall. Hearing was reduced in the left ear.

Following tonsillectomy and adenoidectomy and removal of the aural polyp, the patient was kept under treatment for several months, during which the aural discharge diminished and became less foul. He contracted an infection of the upper respiratory tract in January and did not return to the clinic until March 7, 1941. The history was that on February 2 he suffered a "lightning stroke" of the left side of the face, which gradually subsided. On February 10, measles developed, and the aural discharge increased. On March 2 headache developed, followed by deep orbital pain on the left side; four days later backache and stiffness of the neck appeared, with difficulty in walking and sitting.

On examination he appeared acutely ill and stuporous but responded rationally to persistent questioning. The left pupil was much larger than the right; both reacted sluggishly to light and in accommodation, especially the right, which was almost fixed. The nose was filled with mucopurulent discharge. There was slight asymmetry of the face on swallowing. A purulent foul discharge came from the left ear; no mastoid tenderness or periosteal thickening was noted. The neck was rigid and retracted; cervical lymph nodes were palpable. The back was rigid, with slight opisthotonos. There were exaggerated breath sounds in the posterior bases of both lungs; a systolic murmur was noted in the second left interspace, not transmitted. The superficial reflexes were normal; the deep patellar reflexes were exaggerated; Kernig's sign and Brudzinski's sign were present; Babinski's reflex was absent.

Examination of the blood showed a hemoglobin content of 81 per cent, a red blood cell count of 4,450,000 and a white cell count of 13,800, with 80 per cent polymorphonuclear leukocytes, 8 per cent lymphocytes and 2 per cent monocytes. The spinal fluid was under increased pressure and turbid; there was no pellicle. Reaction to the Wassermann test was 4 plus; the gold curve was not abnormal. The cell count was 4,500, almost all polymorphonuclears; the Pandy test was positive (4+); the total protein was 0.99 per cent, chlorides 689 mg. per hundred cubic centimeters and sugar 52 mg. per hundred cubic centimeters. The Tobey-Ayer test was negative. Roentgen study of the mastoid processes showed: on the right a mixed cell type, of normal density; on the left the triangle contracted, with a moderately forelying sinus wall. The center of the triangle contained an irregular area of poorly defined loss of bone structure. The antrum was markedly enlarged, consistent with the presence of cholesteatoma. The entire left petrous bone showed density increased, with irregularities along the superior aspect, medial to the arcuate eminence, suggesting chronic petrositis with recent activity.

At this time a diagnosis of septic otitic meningitis, acute exacerbation of otitis media with mastoiditis of the left side, facial paresis of the left side and subsiding postmeasles sinusitis and petrositis was made. A radical mastoidectomy was performed on the left side by the postauricular route. The cortex was necrosed, and the mastoid cells were completely broken down. A dehiscence 1 by 1.5 cm. was found in the center of the tegmen of the middle fossa. The dura was thick, gray, covered with spongy granulations; it was widely exposed and found pulsating and normal in color except for the area of dehiscence. The antrum was enormously enlarged and filled with cholesteatoma, removal of which disclosed a pool of foul greenish pus, necrosed bone and a granulomatous mass within the middle ear. No ossicles were found, but there was a large dehiscence over the facial nerve in the middle ear portion; touching this produced facial twitching. The peritubal cells were necrosed and contained frank pus. No other leads to the apex and no fistula could be located. The mass over the facial nerve was left in situ, the canal and the mastoid cavity were loosely packed with petrolatum gauze and the posterior wound was partly sutured.

While awaiting the result of culture of material from the involved areas sulfanilamide was administered. On the afternoon of the first postoperative day, complete facial paralysis was present on the left, with motor aphasia, complete flaccid paralysis of the right arm and spastic paralysis of the right leg. The right patellar reflex was exaggerated; the left was absent; the right abdominal and cremasteric reflexes were absent. Babinski's reflex was present on the right; the tongue deviated to the right. The left pupil was fixed; the disks were normal. The patient became completely stuporous and unable to swallow.

It was felt that encephalitis or thrombosis of the small venules of the left temporal lobe was present. Culture of material from the mastoid process disclosed pneumococci among other organisms. Sulfapyridine was administered intravenously, and orally when the patient improved sufficiently to swallow. After the third postoperative day there was continuous improvement in the paralysis but the aphasia persisted; he could neither talk nor swallow. On the fourth day he became rational and alert and began to use the right arm and the right leg. The right facial reflexes reappeared on the sixth day, the paralysis began to decrease and he made attempts to speak.

The hospital records made by Dr. Maurice Galpern, our resident, whose unremitting care I believe to be largely responsible for the improvement, indicate that the aphasia was due to edema or localized cerebritis and not to abscess. The mouse inoculation test from the mastoid smear showed a pure infection with pneumococci, type III. A week later, Dr. Benjamin Boshes, the consulting neurologist, found no meningeal signs, moderate weakness of the right side of the palate, the right side of the tongue and the right side of the face and a change from aphasia to dysarthria.

The patient was discharged on April 6, in excellent physical condition. The mastoid wound was healed, and the external canal was dry; the hearing showed a remarkable improvement. The patient had gained 10 pounds (4.5 Kg.) and looked well, although there were still some neurologic findings, as well as dysarthria.

The patient is still under observation and continues to improve. There is a great change for the better in appearance, personality and mental alertness; he is attending a speech school and doing well. The question of latent abscess has been considered, but there are no indications at present that there is such a lesion.

DISCUSSION

DR. ELMER HAGENS: Would you briefly revie syndrome as you saw it?

DR. ALFRED LEWY: About one day after the o tion on this boy, slight right facial paralysis, co paralysis of the arm and the leg on the right sid completed aphasia developed. It was difficult to mine the extent of the asphasia, because he ca with manifest meningitis; he was practically stup His mind cleared rapidly, and that is why I hes to do any exploration of the brain. I am glad not, since this was not definite abscess formatio merely, I believe, thrombosis of the small venu the temporal cortex. Dr. Boshes was inclin believe that it was an abscess and that we should to operate. These cases of temporal lobe synd a considerable number of which have been rep may be explained as thrombosis of the small v of the cortex of the temporal lobe or, it may localized edema or an inflammatory reaction that sides without breaking down.

I want to mention that I am indebted to my re Dr. Galpern, for his attention to the case. He ac such a reputation that every time an intracranial dition was seen during his residency, he was call

Ossifying Fibroma of the Ethmoid Cells the Frontal Sinus. Presented by DR. G WOODRUFF.

A boy aged 13 was admitted to the Illinois Ey Ear Infirmary on Jan. 1, 1942, with the foll history: For the past five years the right eye app to be larger than the left. For two years he ha dizzy spells, occurring approximately once a m at any time of day and usually lasting about minutes. For a year or more there had been p obstruction of the right nasal chamber. Six m ago there had been an operation which the thought was for removal of nasal polyps.

On inspection the right eye appeared to be and farther from the midline than its mate, and sl more prominent. A firm, immovable mass was f the nasal portion of the right orbit. Anterior r copy revealed the upper portion of the right chamber obstructed by a large mass, which push septum over against the left lateral nasal wall. right cornea was 16 mm. in front of the orbital ma the left, 15 mm. The right eye was 4 mm. lower the left and 5 mm. farther from the midline. Op moscopy showed slightly blurred disk margins presence of a venous pulsation and a normal-appe macula. Vision was: right eye, 20/40-3; left 20/20.

A roentgenogram showed marked clouding i region of the right ethmoid cells, especially the an cells, and the right frontal sinus. The bone stru was distorted and thinned, with apparent lateral s of the ethmoid capsule. The right antrum was tomically small, with a thickened membrane. The cipal findings in the ethmoid sinuses were tho an expanding intrinsic pathologic process; the de was not great enough to suggest osteoma, rat mucocele or a nonosseous tumor apparently of ethm origin.

An external frontoethmoid approach similar to used by Jansen and later by Lynch was decide with the patient under local anesthesia. The orbital wall was intact but was displaced laterally 8 mm. When the ethmoid capsule was opened, tissue tumor was found, which involved all the et

as well as the frontal sinus. The growth was friable, but it had exerted considerable pres- mesially as well as laterally, so that the middle ate was thinned out against the upper portion septum, which was pushed well over into the asal chamber. Most of the ethmoid cell parti- were destroyed; a few were partly intact, although cells were invaded. The growth was first dis- out of the frontal sinus, after which the expanded d capsule was thoroughly exenterated. The d-out middle turbinate bone was removed, and conclusion of the operation the nasal chamber, moid area and the frontal sinus formed a single, h-walled cavity. The maxillary and sphenoid s were not invaded but the antroethmoidal wall ushed laterally and downward.

gross specimen consisted of several pieces of a tumor, somewhat fibrous in consistency but not dense or very vascular. There did not appear a definite capsule, and there were hollow spaces g through some portions.

patient made an uneventful surgical recovery. ture taken three weeks after operation still some downward displacement of the right eye. athologic report showed fibro-osteosarcoma, slow g but malignant.

boy was discharged from the hospital three after operation and returned to his home in uthern part of Illinois, with the request that he every few months for examination. In Novem- 42, ten months after the operation, there was a growth of what appeared to be simple hyper- mucosa in the upper anterior portion of the avity and this was removed. At this time Dr. ana Theobald, who did not make the original scopic examination, reviewed the sections of the l tumor and was of the opinion that it was not ant. The original slides, as well as sections from ent biopsy specimen, were sent to Colonel Ash, eported: "I believe I would diagnose the large en as ossifying fibroma. It is true that the blood are of sarcoma type but I doubt that it will size, though, of course, as you have already , it will be extensively expansile and destructive. econd specimen is simply a fragment of sinus showing polypoid hyperplasia on an inflamma- sis. There is no evidence of any tumor."

boy has remained in good health and has gained erably in height and weight during the past two There has been slight swelling of the upper eyelid and tissues near the operative scar on one or two occasions, when he has had acute rhinitis, but this has not occurred within the past year. At the last examination, in September 1944, there were no symptoms or signs of recurrence of the tumor, which I believe supports the conclusion that it was not malignant. The history seems to bear out the opinion that it was slow growing and attained its final size only after several years of development.

DISCUSSION

DR. M. F. SNITMAN: I have been rechecking the histologic slides of about 25 sinal cancers. The customary diagnosis has been squamous cell carcinoma, this term including also those specimens which were typically of the cylindric cell type.

Evaluation of a therapeutic procedure requires a more exacting histologic nomenclature. In not a few cases difficulty arises in the determination between fibroma and fibrosarcoma. In 1 case of so-called fibrosarcoma of the antrum the lesion was removed surgically, and no recurrence has taken place after two and one-half years. Reexamination of the slide from this case permitted a histologic diagnosis of fibroma. There are, however, cases in which fibroma is at the borderline between benign and malignant, which accounts for the frequent discrepancy in the diagnoses submitted by several pathologists.

DR. SAMUEL SALINGER: In giving attention to the ossifying tendency in this tumor, I think one should remember that this is not a rare observation. There have been reports in the literature of bone fragments being found in sinuses and fibrotic tumors, even to the extent of forming perfect islands. Just what the determining factor is in this metaplasia is still unknown. This phase interests me more than the confusion about diagnosis. In the case just presented I think the original diagnosis of fibroma was justified, judging from the appearance of the patient and the slide.

DR. GEORGE WOODRUFF: I am not an expert with the microscope, but I have seen enough specimens go to various pathologists, and good pathologists, to know there will often be diversity of opinion about the same specimen. It is difficult to say with certainty just what is present in some of these tumors.

I believe Dr. Salinger misunderstood what was said concerning the pathologic diagnosis. The original opinion favored osteosarcoma, and the final opinion, ossifying fibroma.

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